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A PROSPECTIVE OBSERVATIONAL STUDY ON COMPARISON OF COMPUTED TOMOGRAPHY AND ULTRASOUND IN EVALUATION OF ACUTE ABDOMEN AMONG ADULTS.

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Abstract.

Background:

To reduce radiation exposure, the goal of this study was to examine the roles of computed tomography and ultrasound in the evaluation of acute abdomen. It also sought to determine whether ultrasound alone would be sufficient in most cases.

Method:

For non-traumatic acute abdominal discomfort that lasted less than three days, 50 adult patients visited the emergency room. This prospective observational study was authorized by the institutional review board. The surgery department of Sharan Nursing Home, Motihari, Bihar performed the radiological evaluation of the abdomen using ultrasonography and CT scans (both non-contrast and contrast-enhanced). Trauma and being pregnant were the exclusion factors.

Results:

There was no statistically significant difference between the overall sensitivity of the ultrasound and the CT ($p = 0.018$). Additionally, there were no appreciable differences between the sensitivity of ultrasound and CT in diagnosing frequent causes of acute abdomen, such as acute cholecystitis, acute appendicitis, intestinal obstruction, pancreatitis, and ureteric calculi. Only patients with retro-caecal appendicitis, cases of intestinal blockage where the transition point needed to be defined, and patients with pancreatitis where the CT Severity index needed to be obtained were candidates for CT.

Conclusion:

Considering that ultrasound has been shown to have a sensitivity that is comparable to CT in the majority of clinical scenarios, we conclude that ultrasound should continue to be the primary imaging modality in all patients with acute abdomen to prevent radiation exposure. It is also a more economical inquiry. As a result, CT should only be used in a small number of clinical circumstances where ultrasound is severely inconclusive.

Recommendation:

Both CT and ultrasonography tests must be conducted to ensure a certain conclusion in acute abdomen cases.

Keywords: Acute abdominal pain, Computed tomography, Ultrasound, Appendicitis, Emergency Department, Submitted: 2023-08-29 Accepted: 2023-09-08

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1. INTRODUCTION.

Abdominal pain in the right lower quadrant is probably one of the most challenging problems in Medicine [1-4]. Clinical examination, white blood cell count, abdominal radiography tests, and abdominal ultrasound are the primary methods used to diagnose acute appendicitis in most patients [1–5]. However, due to these exams' imperfect accuracy, a significant probability of misdiagnosis results in a rate of 15% of negative appendicectomies [1, 2, 6, 7]. Other examination techniques, such as computed tomography and abdominal scintigraphy, have been advocated [2–5] to avoid needless appendix removal.

In addition to clinical and laboratory examinations, computed tomography (CT) and ultrasound are routinely employed. In patients with severe abdominal discomfort, the American College of Radiology advises an abdomen/pelvis CT with a contrast agent [2]. Others support using ultrasound as the principal imaging modality, partly because it is accessible and doesn't subject patients to radiation [3, 4]. Exposure to ionizing radiation during CT increases the risk of radiation-induced cancer. This is a limitation of CT, especially given that young patients use CT more often for diagnostic purposes. This might lead to assessing complementary imaging techniques to CT, like ultrasound and MRI [5]. However, the most precise imaging technology should be employed to avoid missing or delaying diagnoses.

A conditional CT strategy for diagnosing urgent problems, with ultrasound initially and CT following a negative or inconclusive ultrasound, was found to be more effective in a prior study of diagnostic methods for unselected individuals with acute abdominal discomfort [6]. The literature advises using CT in the diagnostic workup of patients who are suspected of having appendicitis for common illnesses causing acute abdominal pain, such as appendicitis [7]. Most literature does not support the use of CT in patients suspected of having diverticulitis because a recent meta-analysis found that the accuracy of ultrasonography (US) and CT were equivalent [8]. One of the biggest drawbacks of ultrasonography is that it is observer-dependent. Because highly skilled observers typically carry out ultrasound in a research environment, its reported accuracy in the literature may be overstated. Additionally, certain patient categories, such as obese patients, women, and particular age groups, particularly women of childbearing age, may have decreased ultrasound accuracy. Contrarily, CT offers great inter-observer agreement for common illnesses that cause acute abdominal pain (such as appendicitis and diverticulitis) and good inter-observer agreement overall [9].

If ultrasound can reliably be utilized for the detection of common causes of abdominal pain in unselected patients presenting to the ED, it will only be an acceptable replacement for CT if its diagnostic accuracy is comparable to that of CT. To reduce radiation exposure, the goal of this study was to examine the role of ultrasound and computed tomography in the evaluation of acute abdomen. We also sought to determine whether ultrasound alone would be sufficient in most cases.

2. METHODS.

100 adults participated in this prospective observational study from March 2022 to January 2023. Patients who presented with acute abdominal pain lasting 24 hours or less and not caused by trauma or pregnancy were included.

Patients with acute abdominal discomfort at Sharan Nursing Home, Motihari, Bihar had their clinical histories and examination results documented, and the treating physician made a provisional clinical diagnosis of acute abdomen in these patients. The patients were sent to the radiology department for a USG and/or whole-abdomen CT scan to determine the potential reason. The results of an ultrasonography were compared to a tentative clinical diagnosis. Patients who could not receive a conclusive diagnosis from ultrasound or those in whom the clinician had recommended a CT whole abdomen to learn more about the ultrasound diagnostic were given a CT scan. The

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results of the CT scan were also correlated with the preliminary clinical diagnosis. Cases in which the USG/CT scan failed to reveal the acute abdomen's underlying cause were classified as inconclusive. The final diagnosis, which was confirmed based on follow-up and post-operative observations in patients who had surgical care, was compared with the diagnosis made by USG and CT.

2.1. Statistical Analysis.

All patient demographic information is entered into Microsoft Excel and put through statistical testing with SPSS v21 running on Windows 10. Analytical statistics such as proportions and percentages are used to portray all of the descriptive statistics in tabulations. Analyses are done on the ultrasound's sensitivity in contrast to CT scans. A <0.05 p-value was regarded as statistically significant.

3. RESULTS.

50 patients who met the inclusion criteria and reported to the emergency room complaining of acute abdominal discomfort were included in the current prospective study. At the initial stage, 120 patients were examined for eligibility, however, 70 patients were excluded from this study due to not being eligible. Following the receipt of informed consent, participants were enrolled in the current study. The initial imaging test carried out on these patients was an ultrasound. For patients in whom ultrasound could not provide a conclusive diagnosis or in whom the clinician had recommended the patients for CT abdomen and pelvis to learn more about the ultrasound diagnostic, CT abdomen and pelvis was performed.

All 50 patients were eligible, with a male-to-female ratio of 3:1. There were 35 male patients and 15 female patients. The participants' average age was 39.38 years. Based on USG alone, 37 were diagnosed. To obtain more information for patient care or to address any equivocal ultrasound findings, 26 (52%) patients underwent assessment by USG and CT scan. In 12 cases, ultrasound altered the clinical diagnosis, in 9 cases where the clinical evidence was equivocal, it determined the cause of the acute abdomen, and in 16 cases it verified the clinical diagnosis. However, in 10 individuals, ultrasonography was not definitive. In 4 cases, a CT scan altered the clinical diagnosis, in 1 clinically unclear case, it identified the cause of acute abdominal discomfort, and in 7 cases, it validated the clinical diagnosis. In one instance, though, it was not conclusive.

Five of the nine individuals in the current study who had acute appendicitis had USG diagnoses that were consistent with the final diagnosis. On a CT scan, four cases were identified. In one case of an appendicular mass, a CT scan was necessary for confirmation and evaluation of the surrounding viscera. Nine cases of acute calculous cholecystitis were identified at USG and successfully treated with laparoscopic cholecystectomy. Out of 10 cases where intestinal blockage was confirmed using USG, 3 cases had the transition point and the underlying cause was determined to be tubercular ileocaecal bowel wall thickening and intussusception. 7 more instances CT scans to pinpoint the site of transition and the source of the intestinal obstruction for surgical planning.

Only 3 of the 8 acute pancreatitis patients were found on ultrasonography, necessitating further imaging by CT scan for severity rating. On CT Scan, 5 instances of pancreatitis were identified. Seven cases of obstructive uropathy were detected by ultrasound, and six of those cases also revealed the location of obstructive ureteric calculi. In one instance, a CT scan was necessary to diagnose a mid-ureteric calculus and a proximal dilatation of the pelvicalyceal system. On ultrasound, bowel perforation could not be identified. Bowel perforation in one case was identified by a CT scan. In one instance, though, it was inconclusive since the perforation was an old, sealed one.

There was a significant difference between the sensitivity of ultrasonography and CT scan in determining the cause of acute abdomen (p value = 0.01). Compared to CT, ultrasound has a sensitivity of 55.56% for diagnosing acute appendicitis. In comparison to CT, ultrasound had a sensitivity of 37.50% for diagnosing acute pancreatitis. When it came to identifying intestinal obstruc-

Table 1: **Conditions causing acute abdomen**

Conditions	**Frequency**	**Percentage**
Intestinal Obstruction	10	20%
Acute Appendicitis	9	18%
Acute Cholecystitis	9	18%
Acute Pancreatitis	8	16%
Ureteric Colic	7	14%
Bowel Perforation	2	4%
Pelvic Inflammatory Disease	2	4%
Worm Infestation	1	2%
Pyelonephritis	1	2%
Aneurysm	1	2%

Table 2: **USG and CT in acute abdomen evaluation**

	Change in diagnosis	Confirmation of diagnosis	Diagnosis in inconclusive case	Inconclusive Imaging
USG	12 (24%)	16 (32%)	9 (18%)	13 (26%)
CT Scan	4 (8%)	7 (14%)	1 (2%)	1 (2%)

Table 3: **USG and CT in diagnosing conditions of acute abdomen**

Disease Conditions	**Concordance Of USG Findings With Final Diagnosis**	**Cases Missed On USG & Diagnosed On CT**	**CT For Additional Information**
Acute Appendicitis	5	4	1
Intestinal Obstruction	8	2	6
Acute Cholecystitis	9	-	-
Acute Pancreatitis	3	5	3
Ureteric Colic	7	-	1
Bowel Perforation	-	1	-
Pyelonephritis	1	-	-
Worm Infestation	1	-	-
Pelvic Inflammatory Disease	2	-	1
Aneurysm	1	-	1

tion, CT had a 100% sensitivity rate compared to ultrasound's 80%. Only 30% of patients were able to use ultrasound to identify the reason for their intestinal obstruction. Both acute calculous cholecystitis and ureteric colic were completely detectable by ultrasonography.

4. DISCUSSION.

In the current investigation, 50 individuals who had experienced acute stomach pain lasting fewer than three days and visited the emergency room were included. In our investigation, intestinal obstruction (10/50), acute calculous cholecystitis (9/50), acute appendicitis (9/50), acute pancreatitis (8/50), and ureteric colic (7/50) were determined to be the most often occurring illness conditions causing acute abdomen. Aneurysm, pelvic inflammatory disease, and intestinal perforation were some of the additional causes of acute abdomen. This was consistent with research conducted by van Randen et al. [9].

In 37 patients with acute abdomen, the ultrasonography diagnostic and the final diagnosis were in agreement; as a result, the sensitivity of USG in identifying the cause of acute abdomen was 78.72%. These results concur with earlier research by Singh et al., which found that 70% of USG diagnoses agreed with the final diagnosis [3]. The CT has a 96.15% sensitivity. In research with 91 patients, Kersie et al. found that CT scans had an overall sensitivity of 96.0% for identifying the source of acute abdomen [10].

In our study, ultrasound had a sensitivity of 55.56% compared to 100% for CT in diagnosing acute appendicitis. Near the appendix, there was mild free fluid and mesenteric lymph nodes with inflammatory echogenic mesenteric fat. In one instance, appendicoliths were seen as distal acoustic shadowing and intraluminal hyperechoic foci. These USG findings concurred with those of an investigation by Tomizawa et al [11].

In comparison to CT, ultrasound had a sensitivity of 37.50% for diagnosing acute pancreatitis. Three cases of acute pancreatitis out of eight patients were diagnosed by USG. The enlarged, hypoechoic pancreas caused by edoema with blurred borders and peripancreatic free fluid was the ultrasonography characteristic of acute pancreatitis. These findings are in line with a study by Tomizawa et al [11]. Nevertheless, a CT scan was performed in all 8 instances to confirm the diagnosis and to score the severity for future care. On a CT scan, the pancreas appeared enlarged with a shaggy-shaped gland and low or heterogeneous attenuation [13]. There were 4 cases with interstitial pancreatitis in which there was no pancreatic parenchyma necrosis, but the pancreatic gland was enlarged and displayed normal enhancement. Necrotizing pancreatitis was the cause of the other 3 occurrences. The pancreas was enlarged, and parts that did not enhance suggested necrosis. These CT-related findings matched those from earlier investigations by Balthazar EJ [13] and Petroianu et al [14].

When compared to USG in this investigation, CT demonstrated to be an effective and accurate imaging modality for identifying the existence, degree, and aetiology of blockage. In a study by Suri S. et al., similar findings were attained with a sensitivity of 83% for USG to detect intestinal obstruction and a sensitivity of 93% for CT to detect obstruction. For CT and USG, the percentages of finding the obstruction's aetiology were 87% and 23%, respectively [16]. Likewise, similar findings were reached in studies by Saini et al. and Debnath et al. [12, 17].

Few dilated loops of intestinal coils were visible on ultrasound, along with free fluid in the peritoneal cavity. These results were all general. Pneumoperitoneum owing to perforation was discovered by CT scan. According to intra-operative findings, the site of the perforation at the second half of the duodenum was appropriately recognized on the CT scan. CT was shown by Stapakis et al. [18] to be more advantageous than a standard radiograph. According to Furukawa et al. [19], in addition to ascitis, CT can assess the presence of even the tiniest amount of additional luminal air. The USG was 85.71 percent sensitive in determining the origin and location of the ureteric blockage. Due to extensive intestinal gas shadows, USG was unable to determine the cause and location of left hydroureteronephrosis in one case.

A left mid-ureter obstructive calculus was discovered by CT scan.

5. CONCLUSION.

Because it was discovered to have a sensitivity comparable to CT in the majority of clinical scenarios, we suggest that ultrasonography should continue to be the primary imaging modality in all patients with acute abdomen to prevent radiation exposure. It is also a more economical inquiry. As a result, CT should only be used in a small number of clinical cases where USG is significantly unclear or further information regarding the ultrasound diagnosis is required for patient treatment.

6. LIMITATIONS.

The limitations of this study include a small sample population who were included in this study. The findings of this study cannot be generalized for a larger sample population. Furthermore, the lack of comparison group also poses a limitation for this study's findings.

7. RECOMMENDATION.

Both CT and ultrasonography tests must be conducted to ensure a certain conclusion in acute abdomen cases.

8. ACKNOWLEDGEMENT.

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9. LIST OF ABBREVIATIONS.

CT- Computed Tomography
MRI- Magnetic resonance imaging
US/USG- Ultrasonography
ED- Erectile Dysfunction
SPSS- Statistical Package for Social Sciences

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11. Conflict of interest.

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