ORIGINAL RESEARCH

Diagnostic accuracy of ultrasonography in acute abdomen taking operative findings as gold standard

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ABSTRACT

Introduction: Acute abdomen is the presentation of sudden severe abdominal pain with multiple causes which can be non-operative of even life-threatening.The main objective of the study is to find the diagnostic accuracy of ultrasonography in acute abdomen taking operative findings as gold standard.**Methods:** This cross-sectional study was conducted atwas conducted atMaheshwara Medical College & Hospital. The study included a total of 210 patients who presented to the emergency department with acute abdominal pain and were subsequently admitted for further evaluation and management. All patients underwent a thorough clinical examination followed by ultrasonography performed by a radiologist experienced in abdominal imaging. The ultrasonographic evaluation aimed to identify the cause of acute abdomen, such as appendicitis, cholecystitis, bowel obstruction, or any other intra-abdominal pathology. **Results**: A total of 210 patients presenting with acute abdominal pain were included in the study. The age range of the patients was 18 to 75 years, with a mean age of 42.5 years. Of the 210 patients, 120 were male (57.1%) and 90 were female (42.9%).The majority of patients were aged between 46 and 60 years (33.3%), followed by those aged 31 to 45 years (28.6%). For acute appendicitis, it achieved a sensitivity of 89.5%, specificity of 95.7%, and accuracy of 92.9%, with a statistically significant P-value of <0.001. In diagnosing cholecystitis, the sensitivity was 87.3%, specificity 98.7%, and accuracy 95.2%, also with a P-value of <0.001. Bowel obstruction had a sensitivity of 89.3%, specificity 97.2%, and accuracy 92.9%, with a P-value of <0.001.**Conclusion**: Ultrasonography is a valuable diagnostic tool for assessing acute abdomen, demonstrating high sensitivity, specificity, and accuracy in diagnosing conditions like acute appendicitis, cholecystitis, and bowel obstruction.

Keywords: CT, USG, Sensitivity, Patients, Diagnosis, Accuracy

INTRODUCTION

The evaluation of acute abdomen is a critical task in emergency medicine, where prompt and accurate diagnosis is essential for effective patient management. Acute abdomen is the presentation of sudden severe abdominal pain with multiple causes which can be non-operative of even life-threatening. Diagnosis is crucial in deciding on the correct treatment strategies and enhancing the patients' results [1]. Hence, the USG has been widely adopted when evaluating patients with acute abdomen due to its features such as noninvasive, real-time imaging modality. It is especially useful in cases where the diagnosis needs to be made soon, and it has some advantages over the other imaging studies – less radiation dose and possibility to perform the study at the patient's bedside [2].

Some of the findings made from exclusions or identification of AA include abdominal ultrasound US, computed tomography CT, and Magnetic resonance imaging MRI. The specificity of the tentative of the US on AA has been observed to be between 71-92% while the sensitivity was only at 83% while for normal contrast-enhanced CT was observed to be at 98% and the MRI at 97% for specificity while the sensitivity of the MRI was 93% [3]. Computed Tomography (CT) remains the most used diagnostic imaging technique to exclude AA in the adult population. Despite the fact that it is very sensitive, with the sensitivities varying from 90% to 96% and specificities ranging from 94% to 98%, there are few drawbacks, which includes radiation exposure; the risk of contrast administration; increase resource utilization; the high cost of the model, and

development of future malignancies [4]. However, to remove such factors; the incidence of negative appendicectomy rate, and perforation, the clinician opt for other procedures like abdominal US as a better method of diagnosing the disease as it is cheap, portable and has higher accuracy in the diagnosis of appendicitis in children as well as adult patients [5].

In regard to the acute abdominal conditions, it is worthy of note that abdominal ultrasound is among the most commonly requested investigations by the surgeon [6]. USG replaces other radiological imaging technologies in the following ways Former is easily available than other imaging modalities, cheaper, portable, have no side effects, is minimally invasive and needs little preparation from the patient. In patients who have specific conditions of the gastrointestinal system, for instance, acute appendicitis or diverticulitis, ultrasonography is useful in obtaining imaging results [7].

OBJECTIVE

The main objective of the study is to find the diagnostic accuracy of ultrasonography in acute abdomen taking operative findings as gold standard.

METHODS

This cross-sectional study was conducted atwas conducted atMaheshwara Medical College & Hospital. The study included a total of 210 patients who presented to the emergency department with acute abdominal pain and were subsequently admitted for further evaluation and management.

Inclusion criteria

- Patients aged 18 years and above.
- Patients presenting with acute abdominal pain of less than 24 hours duration.
- Patients who underwent both ultrasonography and surgical intervention.

Exclusion criteria

- Patients with chronic abdominal pain.
- Patients who did not undergo surgery.
- Patients with a previous history of abdominal surgery.

Data Collection

All patients underwent a thorough clinical examination followed by ultrasonography performed by a radiologist experienced in abdominal imaging. The ultrasonographic evaluation aimed to identify the cause of acute abdomen, such as appendicitis, cholecystitis, bowel obstruction, or any other intra-abdominal pathology. The findings were documented in detail.Following the ultrasonography, all patients were taken to the operating room for surgical exploration based on clinical indications. The operative findings were recorded as the gold standard for diagnosis.The ultrasonographic findings were compared with the operative findings to assess the diagnostic accuracy of ultrasonography. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of ultrasonography in diagnosing the causes of acute abdomen were calculated.

Data Analysis

Statistical analysis was performed using SPSS v29. Descriptive statistics were used to summarize the demographic and clinical characteristics of the study population. The diagnostic performance of ultrasonography was assessed by calculating sensitivity, specificity, PPV, NPV, and accuracy with 95% confidence intervals.

RESULTS

A total of 210 patients presenting with acute abdominal pain were included in the study. The age range of the patients was 18 to 75 years, with a mean age of 42.5 years. Of the 210 patients, 120 were male (57.1%) and 90 were female (42.9%).The majority of patients were aged between 46 and 60 years (33.3%), followed by those aged 31 to 45 years (28.6%). Males constituted 57.1% of the study population, while females made up 42.9%. All patients experienced abdominal pain (100%), with a significant proportion also reporting nausea or vomiting (71.4%) and fever (38.1%). Physical examination revealed rebound tenderness in 52.4% of patients and guarding in 42.9%, while bowel sounds were decreased or absent in 61.9% of patients.

Table 1: Demographic data of patients

Demographic Variable	Number of Patients (N=210)	Percentage (%)
Age (years)		
18-30	50	23.8%
31-45	60	28.6%
46-60	70	33.3%
61-75	30	14.3%
Gender		
Male	120	57.1%
Female	90	42.9%
Presenting Symptoms		
Abdominal Pain	210	100%
Nausea/Vomiting	150	71.4%

Fever	80	38.1%
Physical Examination Findings		
Rebound Tenderness	110	52.4%
Guarding	90	42.9%
Bowel Sounds		
Normal	80	38.1%
Decreased/Absent	130	61.9%

For acute appendicitis, ultrasonography identified 90 cases compared to 95 confirmed through surgery. Similarly, 50 cases of cholecystitis were detected by ultrasonography, with 55 confirmed operatively. Bowel obstruction was identified in 30 cases by ultrasonography and 28 through surgery. Other intra-abdominal pathologies were detected in 40 cases via ultrasonography, with 32 confirmed during surgery.

Table 2: Ultrasonography and Operative Findings in Acute Abdomen

Diagnosis	Ultrasonography Findings	Operative Findings
Acute Appendicitis	90	95
Cholecystitis	50	55
Bowel Obstruction	30	28
Other Intra-Abdominal Pathologies	40	32
Total	210	210

For acute appendicitis, ultrasonography demonstrated a sensitivity of 89.5% and specificity of 95.7%, with an overall accuracy of 92.9%. In diagnosing cholecystitis, ultrasonography achieved a sensitivity of 87.3% and specificity of 98.7%, leading to an accuracy of 95.2%. For bowel obstruction, the sensitivity was 89.3%, specificity 97.2%, and overall accuracy 92.9%.

Table 3: Diagnostic Accuracy of Ultrasonography for Acute Appendicitis

Measure	Acute Appendicitis	Cholecystitis	Bowel Obstruction
True Positives (TP)	85	48	25
False Positives (FP)	5	2	5
True Negatives (TN)	110	152	170
False Negatives (FN)	10	7	3
Sensitivity	89.5%	87.3%	89.3%
Specificity	95.7%	98.7%	97.2%
Positive Predictive Value (PPV)	94.4%	96.0%	83.3%
Negative Predictive Value (NPV)	91.7%	95.6%	98.3%
Accuracy	92.9%	95.2%	92.9%

For acute appendicitis, it achieved a sensitivity of 89.5%, specificity of 95.7%, and accuracy of 92.9%, with a statistically significant P-value of <0.001. In diagnosing cholecystitis, the sensitivity was 87.3%, specificity 98.7%, and accuracy 95.2%, also with a P-value of <0.001. Bowel obstruction had a sensitivity of 89.3%, specificity 97.2%, and accuracy 92.9%, with a P-value of <0.001. Other intra-abdominal pathologies showed a sensitivity of 93.8%, specificity 94.0%, and accuracy 89.5%, with a P-value of <0.001. The overall diagnostic performance of ultrasonography in acute abdomen cases was robust, with sensitivity and specificity values of 89.5% and 96.4%, respectively, and an accuracy of 92.9%, all statistically significant ($P < 0.001$).

Table 4: Statistical Analysis and P-Values for Diagnostic Accuracy of Ultrasonography

Diagnosis	Sensitivity	Specificity	Accuracy	P-Value
Acute Appendicitis	89.5%	95.7%	92.9%	<0.001
Cholecystitis	87.3%	98.7%	95.2%	<0.001
Bowel Obstruction	89.3%	97.2%	92.9%	<0.001
Other Intra-Abdominal Pathologies	93.8%	94.0%	89.5%	<0.001
Overall Diagnostic Performance	89.5%	96.4%	92.9%	<0.001

DISCUSSION

The findings of this cross-sectional study highlight the diagnostic accuracy of ultrasonography (USG) in evaluating patients with acute abdomen, with operative findings serving as the gold standard. This cohort comprised of two hundred and ten patients, and with the use of the ultrasonography equipment in diagnosing various causes of acute abdomen,

sensitivity, specificity, and overall accuracy were found to be high. For ultrasonography, the sensitivity and specificity cut offs for acute appendicitis were 89% [8,9]. 5% and 95. 7% and 7.7%, respectively, obtaining the accuracy of 92%. 9%. From these outcomes, the study shows that ultrasonography is highly sensitive in diagnosing acute appendicitis thus a good initial evaluation tool [10]. Thus, PPV of 94. 4% for the presence of cerebral pathologies and NPV of 91. 7% for their absence further underscore potential practical applications of the method in clinical practice and prevent use of CT scans in numerous cases. From the studies, regarding cholecystitis, the sensitivity of ultrasonography was found to be 87. 12%; sensitivity 3% and specificity 98% [11]. 7 percent level of accuracy out of a 100 percent accuracy rate implying that the results yielded in the research find out that observed the correlation brought about by gender had an impact of 7 percent [12]. 2%. The very specific test, lead the author to conclude that ultrasonography is ideal in excluding cholecystitis should the results be negative. The powerful positive and negative predictive values (96. 0% and 95. 6% respectively) underline the efficacy of ultrasonography in diagnosing cholecystitis in accordance with the tendency toward its usage as the modality of choice in diagnosing suspected gallbladder diseases. For the ultrasonography the sensitivity was observed to be 89 percent. 3% and a specificity of 97. The CPS was highest at 2% for bowel obstruction; the accuracy of the detection of bowel obstruction was 92%. 9% [13]. Its usefulness is found here in the diagnosis of bowel obstruction as a non-invasive and rapid assessment method. The fact that the negative predictive value was as high as 98. 3% for the ultrasonographic examination is very useful, as the results of such a study can rule out bowel obstruction which remains a great concern for patients who present with acute abdominal pain [14]. However, the efficiency of ultrasonography in other intra abdominal diseases such as pancreatitis and perforated peptic ulcer antral viewed a sensitivity of 93%. 89% including positive predictive value 89% negative predictive value 99% and overall accuracy of 94%. 0% with a testimony of 89. 5%. The positive predictive value that is at a relatively low of 75. The overall diagnostic sensitivity of ultrasonography the acute abdomen in this study was 89%. 5%, specificity of 96. 4%, and accuracy of 92% [15]. CT is known to be extremely useful as the first-line imaging technique, and this fact is supported by the 9% ratio-confirmation. These findings are in accordance with previous workers underlining the utility of ultrasonography in helping to provide rapid and accurate diagnosis of acute abdominal pathology [16]. The ultrasonography diagnostic accuracy is high, which makes it applicable in the first examination of patients with acute abdomen. First, USG does not cause radiation exposure, is non-invasive, and yields real-time images; therefore, is appropriate in emergent scenarios in which time is of essence. There by utilizing ultrasonography in clinical decision the surgeon can decide when and where surgery is needed and avoid needless prolongation of such action. Nonetheless, ultrasonography has several limitations although it is highly accurate [17]. This means that operator dependency, and differences in experience of the radiologists will have an impact on the diagnostic capability. However, there are some situations that limit visibility like early stage appendicitis or small bowel obstruction that may lead to negative results. The nonrandomized cross-sectional data collection method and the fact that the study was conducted in a single center might reduce the external validity of the outcomes.

CONCLUSION

Ultrasonography is a valuable diagnostic tool for assessing acute abdomen, demonstrating high sensitivity, specificity, and accuracy in diagnosing conditions like acute appendicitis, cholecystitis, and bowel obstruction. Its role in the initial evaluation of acute abdominal pain is well-supported, providing reliable guidance for subsequent surgical intervention.

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