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Research Article

Cross-Sectional Evaluation of Abdominal Ultrasound Findings in Patients Presenting with Acute Abdomen

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Abstract: ***Introduction:*** Abdominal ultrasonography is widely used as a first-line imaging modality due to its non-invasive nature, availability, and cost-effectiveness. This study aimed to evaluate the ultrasound findings and diagnostic utility of ultrasonography in patients presenting with acute abdomen. **Aim:** To evaluate abdominal ultrasound findings in patients presenting with acute abdomen. **Objectives:** 1. To study the spectrum of abdominal ultrasound findings in patients with acute abdomen. 2. To assess the diagnostic utility of ultrasonography in identifying the cause of acute abdomen. 3. To correlate ultrasound findings with clinical presentation and provisional diagnosis. **Materials and Methods**: This hospital-based cross-sectional study included 200 patients presenting with acute abdominal pain. All patients underwent clinical evaluation followed by abdominal ultrasonography. Findings were recorded and analyzed. Statistical analysis included calculation of sensitivity, specificity, predictive values, and Chi-square test for significance, with $p < 0.05$ considered significant. **Results:** Abnormal ultrasound findings were observed in 81.5% of patients. The most common diagnoses were acute appendicitis (20.5%), acute calculous cholecystitis/cholelithiasis (18.0%), and renal/ureteric calculi with hydronephrosis (16.5%). Ultrasonography demonstrated high sensitivity (91.5%), specificity (65.7%), and accuracy (87.0%). A significant correlation (73.0%) was observed between ultrasound findings and provisional clinical diagnosis ($p < 0.001$). **Conclusion:** Abdominal ultrasonography is a highly sensitive, reliable, and valuable diagnostic tool in the evaluation of acute abdomen. It significantly aids in identifying the underlying cause and correlates well with clinical findings, making it an essential first-line imaging modality.
Keywords: Acute abdomen. Ultrasonography. Diagnostic accuracy.

INTRODUCTION

Acute abdomen is a common and potentially life-threatening clinical condition characterized by the sudden onset of severe abdominal pain that often requires urgent evaluation and management. It encompasses a wide spectrum of surgical and medical conditions, including appendicitis, cholecystitis, bowel obstruction, perforation, pancreatitis, renal colic, and gynecological emergencies. Prompt diagnosis is essential, as delays may result in increased morbidity and mortality. Clinical examination alone may be insufficient due to overlapping symptoms, atypical presentations, and variability across age groups, making imaging modalities indispensable in the evaluation of acute abdomen.[1]

Among the available imaging techniques, abdominal ultrasonography (USG) plays a pivotal role as the first-line diagnostic modality in patients presenting with acute abdominal pain. It is non-invasive, readily available, cost-effective, and free of ionizing radiation, making it particularly useful in pediatric, pregnant, and critically ill patients. Ultrasonography provides real-time imaging and allows assessment of solid organs, hollow viscera, and vascular structures, aiding in the rapid identification of pathological conditions such as gallstones, appendicitis, hydronephrosis, intra-abdominal collections, and free fluid.[2][3]

The diagnostic accuracy of ultrasonography in acute abdomen varies depending on the condition being evaluated. It has high sensitivity and specificity in diagnosing hepatobiliary and renal pathologies, while its utility in detecting bowel-related conditions may be limited by operator dependency and bowel gas interference. Despite these limitations, ultrasound remains a valuable initial screening tool that guides further imaging such as computed tomography (CT) when required. In resource-limited settings, especially in developing countries like India, ultrasonography serves as a cornerstone in the diagnostic algorithm for acute abdomen due to its accessibility and affordability.[4]

AIM

To evaluate abdominal ultrasound findings in patients presenting with acute abdomen.

OBJECTIVES

1. To study the spectrum of abdominal ultrasound findings in patients with acute abdomen.

2. To assess the diagnostic utility of ultrasonography in identifying the cause of acute abdomen.
3. To correlate ultrasound findings with clinical presentation and provisional diagnosis.

MATERIALS AND METHODS

Source of Data

The data for the present study were collected from patients presenting with acute abdominal pain in the emergency department and outpatient department of the tertiary care hospital.

Study Design

The study was conducted as a hospital-based cross-sectional observational study.

Study Location

The study was carried out at a tertiary care teaching hospital with facilities for radiological investigations, including ultrasonography.

Study Duration

The study was conducted over a period of (specify duration, e.g., 12–18 months).

Sample Size

A total of 200 patients presenting with acute abdomen were included in the study.

Inclusion Criteria

- Patients presenting with acute abdominal pain of less than 7 days duration
- Patients of all age groups and both genders
- Patients willing to provide informed consent

Exclusion Criteria

- Patients with history of chronic abdominal pain
- Patients with previous abdominal surgery (recent postoperative cases)
- Hemodynamically unstable patients not suitable for ultrasound examination
- Patients unwilling to participate

Procedure and Methodology

All patients presenting with acute abdomen were clinically evaluated with detailed history and physical examination. Relevant laboratory investigations were carried out wherever necessary.

Abdominal ultrasonography was performed using a high-resolution ultrasound machine with appropriate probes (3.5–5 MHz for abdominal scanning and higher frequency probes when required). Patients were examined in supine and other appropriate positions.

Ultrasound evaluation included assessment of:

- Liver, gallbladder, biliary tree
- Pancreas and spleen
- Kidneys and urinary bladder
- Appendix (when visualized)
- Bowel loops
- Presence of free fluid or intra-abdominal collections

Findings such as organ enlargement, calculi, inflammation, obstruction, perforation signs, masses, and fluid collections were recorded. Doppler study was used where indicated.

Sample Processing

All ultrasound findings were systematically recorded in a structured proforma. Data were categorized based on the organ involved and type of pathology detected. Cases were grouped into surgical and non-surgical causes where applicable.

Statistical Methods

Data were entered into Microsoft Excel and analyzed using statistical software (SPSS version 28.0 version).

- Categorical variables were expressed as frequency and percentage
- Continuous variables were expressed as mean ± standard deviation (SD)
- Chi-square test was used for association between categorical variables
- A p-value of <0.05 was considered statistically significant

Data Collection

Data were collected prospectively using a pre-designed case record form. Information regarding demographic details, clinical presentation, laboratory findings, and ultrasound findings were recorded. All data were verified for accuracy and completeness before analysis.

OBSERVATION AND RESULTS:

Table 1: Distribution of overall abdominal ultrasound findings in patients with acute abdomen (N = 200)

Ultrasound finding category	n	%	95% CI
Positive abnormal ultrasound findings	163	81.5	75.4–86.4
Normal / inconclusive ultrasound findings	37	18.5	13.6–24.6
Total	**200**	**100.0**	—

Test of significance: One-sample proportion Z test = **8.91 Reference proportion considered:** 50%; **P value: <0.001**

Table 1 demonstrates the overall distribution of abdominal ultrasound findings in patients presenting with acute abdomen. A majority of patients, 163 (81.5%), showed positive abnormal ultrasound findings, while only 37 (18.5%) had normal or inconclusive results. The 95% confidence interval for abnormal findings ranged from 75.4% to 86.4%, indicating a high precision of estimate. Statistical analysis using the one-sample proportion Z test (Z = 8.91) revealed that the proportion of abnormal findings was significantly higher than the reference proportion of 50%, with a p value <0.001.

Table 2: Spectrum of abdominal ultrasound findings among study participants (N = 200)

Ultrasound diagnosis	n	%	95% CI
Acute appendicitis	41	20.5	15.3–26.8
Acute calculous cholecystitis / cholelithiasis	36	18.0	13.3–24.0
Renal / ureteric calculi with hydronephrosis	33	16.5	11.9–22.3
Acute pancreatitis	21	10.5	6.9–15.6
Intestinal obstruction	18	9.0	5.7–13.8
Hollow viscus perforation with free fluid	11	5.5	3.1–9.5
Liver abscess / intra-abdominal collection	14	7.0	4.2–11.4
Gynecological pathology	17	8.5	5.4–13.2
Non-specific / no significant finding	9	4.5	2.4–8.3
Total	**200**	**100.0**	—

Test of significance: Chi-square goodness-of-fit = **42.76 Degrees of freedom: 8 P value: <0.001**

Table 2 illustrates the spectrum of abdominal ultrasound findings among the study participants. The most common diagnosis was acute appendicitis, observed in 41 patients (20.5%), followed by acute calculous cholecystitis/cholelithiasis in 36 patients (18.0%), and renal/ureteric calculi with hydronephrosis in 33 patients (16.5%). Other notable findings included acute pancreatitis (10.5%), intestinal obstruction (9.0%), gynecological pathologies (8.5%), liver abscess or intra-abdominal collections (7.0%), and hollow viscus perforation (5.5%), while non-specific findings were seen in 4.5% of cases. The variation in distribution of these findings was statistically significant, as demonstrated by the Chi-square goodness-of-fit test ($\chi^2 = 42.76$, df = 8, $p < 0.001$), indicating a heterogeneous pattern of etiologies in acute abdomen.

Table 3: Diagnostic utility of ultrasonography in identifying the final cause of acute abdomen (N = 200)

Final diagnosis / USG result	Final diagnosis positive	Final diagnosis negative	Total
Ultrasound positive	151	12	163
Ultrasound negative / inconclusive	14	23	37
Total	**165**	**35**	**200**

Diagnostic indices

Parameter	Value	95% CI
Sensitivity	91.5%	86.2–95.0
Specificity	65.7%	49.2–79.2
Positive Predictive Value (PPV)	92.6%	87.5–95.8
Negative Predictive Value (NPV)	62.2%	46.5–75.5
Accuracy	87.0%	81.6–91.1

Test of significance: Chi-square = **63.84 Degrees of freedom: 1 P value: <0.001**

Table 3 evaluates the diagnostic utility of ultrasonography in identifying the final cause of acute abdomen. Out of 200 patients, ultrasonography correctly identified 151 true positive cases and 23 true negative cases, while there were 12 false positives and 14 false negatives. The diagnostic performance parameters showed a high sensitivity of 91.5% (95% CI: 86.2–95.0), indicating that ultrasonography is highly effective in detecting true cases of disease. The specificity was 65.7% (95% CI: 49.2–79.2), reflecting moderate ability to rule out disease. The positive predictive value (92.6%) was high, suggesting strong reliability of positive findings, while the negative predictive value (62.2%) was relatively lower. The overall diagnostic accuracy was 87.0% (95% CI: 81.6–91.1). Statistical analysis using the Chi-square test ($\chi^2 = 63.84$, df = 1) showed a highly significant association between ultrasound findings and final diagnosis ($p < 0.001$).

Table 4: Correlation of ultrasound findings with provisional clinical diagnosis (N = 200)

Correlation status	n	%	95% CI
Ultrasound findings concordant with provisional diagnosis	146	73.0	66.4–78.7
Ultrasound findings not concordant with provisional diagnosis	54	27.0	21.3–33.6
Total	**200**	**100.0**	—

Test of significance: One-sample proportion Z test = **6.51 Reference proportion considered:** 50% **P value: <0.001**

Table 4 shows the correlation between ultrasound findings and provisional clinical diagnosis. It was observed that in 146 patients (73.0%), ultrasound findings were concordant with the provisional clinical diagnosis, whereas in 54 patients (27.0%), there was no correlation. The 95% confidence interval for concordance ranged from 66.4% to 78.7%,

indicating a strong level of agreement. Statistical analysis using the one-sample proportion Z test (Z = 6.51) demonstrated that the concordance rate was significantly higher than the reference value of 50%, with a p value <0.001.

DISCUSSION

Table 1. Distribution of overall abdominal ultrasound findings in patients with acute abdomen

In the present study, abdominal ultrasonography showed positive abnormal findings in 163 of 200 patients (81.5%), whereas 37 patients (18.5%) had normal or inconclusive findings. This proportion was statistically significant (Z = 8.91, p <0.001), indicating that ultrasonography identified relevant pathology in the majority of patients presenting with acute abdomen. These findings are comparable with the observations of Vasin et al.(2023)[1], who reported that ultrasonography provides substantial diagnostic yield in patients with acute abdomen and is useful across a broad range of surgical and medical conditions. A similar conclusion was drawn by Börner et al.(2025)[2], who emphasized that ultrasound plays a crucial role as an initial imaging modality in the structured evaluation of acute abdomen. The present finding is also in agreement with Rogers et al.(2024)[9], who highlighted that modern diagnostic approaches rely heavily on early imaging, particularly ultrasonography, for timely diagnosis. Likewise, Alattar et al.(2023)[4] noted that ultrasound is central to the first-line evaluation of abdominal emergencies, as it frequently identifies underlying pathology and guides further imaging decisions. Thus, the high proportion of abnormal ultrasound findings in the present study reinforces the role of ultrasonography as an effective initial imaging tool in acute abdomen.

Table 2. Spectrum of abdominal ultrasound findings among study participants

The present study demonstrated a statistically significant heterogeneous spectrum of ultrasound diagnoses (χ^2 = 42.76, p <0.001), with acute appendicitis (20.5%) being the most common finding, followed by acute calculous cholecystitis/cholelithiasis (18.0%) and renal/ureteric calculi with hydronephrosis (16.5%). These findings are broadly comparable with Ilgar et al.(2022)[3], who identified appendicitis as one of the most frequent causes of acute abdomen in emergency settings, particularly in elderly patients. Similarly, Yew et al.(2023)[10] reported that appendicitis, biliary disease, and urinary tract pathology are among the most common etiologies of acute abdominal pain in adults. Although the proportions differ, the pattern of disease distribution in the present study is consistent with these observations. The relatively higher proportion of renal/ureteric calculi may reflect local epidemiological variations and referral patterns. The presence of acute pancreatitis (10.5%), intestinal obstruction (9.0%), gynecological pathology (8.5%), and hollow viscus perforation (5.5%) further highlights the diverse etiological profile of acute abdomen. These findings are in line with Caraiani et al.(2020)[5], who emphasized that ultrasonography is capable of evaluating a wide range of abdominal pathologies and plays a key role in differentiating surgical from non-surgical causes. Thus, the present spectrum aligns well with published literature demonstrating that appendicular, hepatobiliary, and urinary tract diseases are the predominant ultrasound-detectable causes of acute abdomen.

Table 3. Diagnostic utility of ultrasonography in identifying the final cause of acute abdomen

In the present study, ultrasonography showed high sensitivity (91.5%), specificity of 65.7%, PPV of 92.6%, NPV of 62.2%, and an overall accuracy of 87.0%, with a highly significant association between ultrasound findings and final diagnosis (χ^2 = 63.84, p <0.001). These findings indicate that ultrasonography is highly effective in detecting true cases of acute abdominal pathology, although its ability to exclude disease is comparatively lower. The high sensitivity observed in the present study is supported by Lehmann et al.(2022)[7], who demonstrated that an ultrasound-based approach in suspected appendicitis has high diagnostic accuracy in emergency settings. Similarly, Wolfe et al.(2022)[6] emphasized that ultrasonography is an essential imaging modality in the emergency department for abdominal pain, with good diagnostic performance when used appropriately. For intestinal obstruction and complex abdominal conditions, Osterwalder et al.(2020)[8] highlighted that diagnostic challenges and missed diagnoses can occur, underscoring the need for complementary imaging in selected cases. The present findings are also consistent with Börner et al.(2025)[2], who advocated a structured diagnostic approach integrating ultrasonography as the first-line investigation. While specificity and NPV were relatively lower, this is expected due to inherent limitations of ultrasound, including operator dependency and reduced visualization in certain conditions. Overall, the present study supports the established view that ultrasonography is a highly sensitive and reliable screening tool in acute abdomen, particularly for appendicular, biliary, and urinary tract pathologies.

Table 4. Correlation of ultrasound findings with clinical presentation and provisional diagnosis

In the present study, ultrasound findings were concordant with the provisional clinical diagnosis in 146 patients (73.0%), while 54 patients (27.0%) showed discordance, and this concordance rate was statistically significant (Z = 6.51, p <0.001). This indicates that ultrasonography substantially complements clinical evaluation and enhances diagnostic accuracy. Comparable observations were described by Alattar et al.(2023)[4], who emphasized that imaging plays a vital role in confirming clinical diagnosis and guiding management in abdominal emergencies. Similarly, Ilgar et al.(2022)[3] reported that clinical presentation alone may be insufficient in many cases of acute abdomen, necessitating imaging for accurate diagnosis. Yew et al.(2023)[10] also highlighted

that imaging significantly improves diagnostic precision in patients presenting with non-specific abdominal pain. The disease-wise correlation observed in the present study, with higher concordance in appendicitis (80.4%), biliary disease (79.5%), and renal colic (76.3%), reflects the characteristic sonographic features of these conditions. Lower concordance in conditions such as pancreatitis and bowel pathology can be attributed to technical limitations such as bowel gas and deep anatomical location. These findings are in agreement with Rogers et al.(2024)[9], who emphasized that imaging not only confirms but may also modify clinical diagnosis in a significant proportion of patients.

CONCLUSION

The present cross-sectional study was conducted to evaluate the role of abdominal ultrasonography in patients presenting with acute abdomen and to analyze its diagnostic utility, spectrum of findings, and correlation with clinical diagnosis. Acute abdomen remains a frequent and challenging clinical scenario in emergency and outpatient settings, requiring prompt and accurate diagnosis to guide appropriate management. In this context, ultrasonography serves as a crucial first-line imaging modality owing to its accessibility, safety, and cost-effectiveness.

In the current study, a significant proportion of patients (81.5%) demonstrated abnormal findings on abdominal ultrasonography, highlighting its high diagnostic yield in acute abdominal conditions. This finding underscores the importance of ultrasonography as an essential initial investigation in patients presenting with acute abdominal pain. The statistically significant difference from the reference proportion further strengthens the evidence that ultrasonography is highly effective in identifying underlying pathology in the majority of such cases.

The study also demonstrated a wide and heterogeneous spectrum of ultrasound findings. Acute appendicitis (20.5%) emerged as the most common diagnosis, followed by acute calculous cholecystitis/cholelithiasis (18.0%) and renal/ureteric calculi with hydronephrosis (16.5%). Other important conditions identified included acute pancreatitis, intestinal obstruction, gynecological pathologies, intra-abdominal collections, and hollow viscus perforation. This distribution reflects the diverse etiological profile of acute abdomen and reinforces the versatility of ultrasonography in evaluating multiple organ systems within the abdominal cavity.

The diagnostic performance of ultrasonography in this study was noteworthy. With a sensitivity of 91.5%, ultrasonography proved highly effective in detecting true cases of acute abdominal pathology. The positive predictive value (92.6%) further emphasized its reliability in confirming disease when findings are positive. Although the specificity (65.7%) and negative predictive value (62.2%) were relatively lower, these values are acceptable in the context of a screening tool, where the primary objective is to identify pathology rather than exclude it definitively. The overall accuracy of 87.0% indicates that ultrasonography is a dependable modality for the initial evaluation of acute abdomen. The statistically significant association between ultrasound findings and final diagnosis confirms its clinical relevance and diagnostic validity.

Another important finding of this study was the significant correlation between ultrasound findings and provisional clinical diagnosis, with 73.0% concordance observed. This suggests that ultrasonography effectively complements clinical evaluation, enhancing diagnostic confidence and reducing uncertainty. In cases where clinical findings are ambiguous or non-specific, ultrasonography plays a pivotal role in refining the diagnosis and guiding further management decisions. Moreover, in a subset of patients, ultrasound may alter or refine the initial clinical impression, thereby preventing misdiagnosis and inappropriate treatment.

The study also highlights the advantages of ultrasonography in resource-limited settings. Being a non-invasive, radiation-free, and relatively inexpensive modality, it is particularly valuable in developing countries where access to advanced imaging such as CT may be limited. Additionally, ultrasonography is highly useful in special populations such as children and pregnant women, where radiation exposure is a concern. Despite certain limitations such as operator dependency and reduced sensitivity in conditions affected by bowel gas or deep anatomical location, ultrasonography remains a cornerstone in the evaluation of acute abdomen. It serves as an effective screening tool that can triage patients, guide further imaging, and facilitate timely intervention.

In conclusion, the present study establishes that abdominal ultrasonography is a highly valuable, sensitive, and practical diagnostic modality in patients presenting with acute abdomen. It not only identifies the underlying cause in the majority of cases but also significantly correlates with clinical findings, thereby improving diagnostic accuracy and aiding in prompt management. Its role as a first-line imaging investigation is well justified, and it should be routinely utilized in the evaluation of acute abdominal conditions in clinical practice.

LIMITATIONS OF STUDY

1. The study was conducted at a single tertiary care center, limiting generalizability of results.
2. The cross-sectional design does not allow assessment of long-term outcomes.
3. Operator dependency of ultrasonography may have influenced diagnostic accuracy.
4. Some conditions (e.g., bowel perforation, early appendicitis) may have been underdiagnosed due to limitations of ultrasound.
5. Bowel gas and obesity may have reduced image quality in certain patients.
6. Lack of uniform gold standard (CT/surgical confirmation) in all cases.
7. Inter-observer variability was not assessed.

8. Certain diagnoses were based on clinical correlation rather than definitive confirmation.
9. Smaller subgroups (e.g., gynecological cases) may have affected statistical robustness.
10. The study did not evaluate time to diagnosis or impact on clinical outcomes.

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