

## Role of Ultrasonography in the Diagnosis and Management Decision-Making of Acute Abdomen

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### Abstract:

**Background:** Acute abdomen is a common surgical emergency requiring rapid diagnosis. Ultrasonography (USG), with its real-time imaging and safety profile, has become a key first-line modality.

**Aim:** To evaluate the role of ultrasonography in diagnosing acute abdomen and its impact on management decision-making.

**Methodology:** A prospective observational study was conducted at Department of General surgery, Patna Medical College and Hospital, Patna, Bihar, India. 68 patients (1–80 years) presenting with acute abdominal pain over seven months. All patients underwent clinical evaluation, laboratory tests, and ultrasonography. Findings were correlated with final diagnosis and management outcomes.

**Results:** USG demonstrated high diagnostic accuracy, with overall sensitivity reaching up to 100% in several conditions. It was diagnostic in 76.47% of cases, with only 4.41% misdiagnosis and 19.12% requiring further tests. USG confirmed clinical diagnosis in 58.82%, altered it in 14.71%, and aided differential diagnosis in 17.65%. Most patients (58.82%) were managed conservatively, while 41.18% required surgery.

**Conclusion:** Ultrasonography is a reliable, non-invasive, and effective first-line tool in acute abdomen, significantly aiding diagnosis and guiding management decisions, though complementary investigations may be needed in select cases.

**Keywords:** Ultrasonography, Acute Abdomen, Diagnosis, Sensitivity, Management Decision, Surgical Evaluation.

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### Introduction

Ultrasonography is one of the most significant inventions that has transformed modern medicine among many others. Ultrasound has over the years proven to be a necessity in the diagnostic modality of the field especially in the field of surgery. Its uses are growing at a high rate due to the superior efforts put in the special institutes and clinical environments [1]. Its usefulness has been then improved by the development of high-resolution imaging, portability, and real-time visualization such that ultrasonography is now an inseparable part of modern medical practice.

The abdomen or the so-called magic box is a particular diagnostic problem since the organs and pathologies that it includes are of exceptional

diversity. Acute abdomen is a name to describe a set of signs and symptoms, which are characterized by pain and tenderness in the abdominal area and may urgent surgical assessment and treatment may be required [2]. This is a life-threatening situation in the emergency medical field and surgical practice, in which timely diagnosis and decision-making are essential to avoid morbidity and mortality. The confusion of acute abdominal cases demands a logical and fast means of diagnosis to define whether the operative treatment is needed or not, as well as to begin the treatment as soon as possible.

Abdominal pain remains one of the most common symptoms that are encountered in the routine practice of surgery. Although there are improved

clinical examination methods, in some cases, it may be difficult to easily find the precise cause of abdominal pain based on clinical grounds only. In turn, doctors often use adjunctive studies as a way of validating or narrowing down their clinical diagnosis. Ultrasonography is one of them, where it has become a preferred first-line method of imaging because it is available and accurate in diagnosis [3]. Interestingly, only a quarter of patients initially diagnosed as having an acute abdomen later on end up having to undergo surgery. This brings out a major clinical dilemma, which is knowing which patients actually require surgery and the urgency of those interventions. To prevent unnecessary surgery and maximize patient outcomes, proper and prompt distinction between surgical and non-surgical causes is hence necessary.

In spite of the fact that a detailed physical examination is the basis of the diagnosis, it is not always sufficient on its own. There is a lot of need in most instances to have other diagnostic support to come up with a conclusive decision. Ultrasonography offers this important support because it offers real-time imaging of the abdominal structures thus helping in the identification of pathological changes [4]. It is highly important not only in diagnosis, but also in informing management decisions particularly in emergency setting. It is an invaluable tool in acute care, as it is useful in determining conditions like appendicitis, cholecystitis, intestinal obstruction and intra-abdominal fluid collections in a remarkably short time.

Ultrasonography safety profile is one of the major benefits of ultrasonography. It is non-invasive, radiation-free and less expensive imaging which can be done repeatedly without exposing the patient to any harm. It is especially appropriate in vulnerable groups like children, pregnant women, and critically ill patients [5] by this reason. Moreover, ultrasonography is not very complicated to carry out and exhibits no important contraindications further expanding its use in various clinical settings. High-resolution imaging has also contributed significantly to the accuracy of diagnosis by allowing clinicians to observe any slight pathological changes [6] only with high-resolution imaging.

The other significant advantage of ultrasonography is that it is versatile and can be visualized in real-time. In comparison to other imaging methods, ultrasound makes it possible to dynamically assess abdominal organs, which allows the study of the movement of organs and their peristalsis and fluid dynamics. Doppler technology also further expands its diagnostic capabilities as it allows visualization of blood flow and measuring vascular dynamics. It is especially applicable in the circumstances where vascular compromise or change of perfusion is important.

Ultrasound units have also been miniaturized and made more portable due to technological advances. The latest devices are small and can be carried around easily, making them applicable in many clinical settings, such as bedside, emergency department, operating rooms, and radiology suites [7] and the like. This portability alone is particularly useful during emergency cases when faster evaluation is needed. Also, miniaturized high-resolution transducers have been developed, which have enabled ultrasonography to be applied in minimally invasive surgeries including laparoscopic and endoscopic surgeries and thus expanded the role of ultrasonography in surgery.

However, there are limitations of ultrasonography despite the many benefits of technology. Its operator dependency is one of the major issues that come with its usage. The skill and experience of the examiner have a great impact on the quality of imaging and accuracy of interpretation. Expert divergence may thus affect diagnostic reliability. However, through proper training and experience, ultrasonography is a very useful and dependable diagnostic method.

When it comes to acute abdomen, ultrasonography does not just serve a diagnosis purpose. It plays an important role in clinical decision-making by assisting clinicians in deciding whether surgical intervention is necessary or not, ranking cases in order of severity, and tracking disease progression or response to treatment. Its speed of getting it and the ability to give instantaneous results make it especially desirable in an emergency environment where time is essential.

### Methodology

**Study Design:** This study was designed as a prospective observational study aimed at evaluating the role of ultrasonography in the diagnosis and management decision-making of patients presenting with acute abdomen. The study focused on assessing the diagnostic accuracy of ultrasonography and its impact on clinical decisions.

**Study Area:** The study was conducted in the Department of General surgery, Patna Medical College and Hospital, Patna, Bihar, India.

**Study Duration:** The study was carried out over a period of seven months from March 2025 to September 2025.

**Sample Size:** A total of 68 patients were included in the study. The sample size comprised all eligible patients presenting during the study period who satisfied the inclusion and exclusion criteria.

**Study Population:** The study population included patients aged between 1 and 80 years, comprising both males and females, who presented with acute onset abdominal pain and required hospital

admission. These patients were clinically suspected to have acute abdominal conditions requiring further evaluation.

**Data Collection:** Data were collected using a pre-designed and structured proforma. Information recorded included demographic details, clinical history, presenting symptoms, physical examination findings, laboratory investigations, ultrasonography findings, and final diagnosis. Ultrasonography was performed using a real-time scanner with a 3.75 MHz probe for abdominal imaging and a 5 MHz probe for transvaginal or transrectal imaging when required.

#### Inclusion Criteria

- Patients aged 1–80 years
- Patients presenting with acute onset abdominal pain
- Non-traumatic cases
- Patients admitted to the hospital for evaluation

#### Exclusion Criteria

- Patients with a history of abdominal trauma
- Patients with chronic abdominal pain
- Patients attending the outpatient department (OPD) without admission
- Patients unwilling to participate

**Procedure:** All selected patients underwent a detailed clinical evaluation, including history taking and physical examination, followed by routine laboratory investigations. Ultrasonographic examination of the abdomen was then performed. The findings of ultrasonography were recorded and compared with clinical diagnosis, intraoperative findings in cases undergoing surgery, and final

diagnosis at discharge. Based on these findings, management decisions, whether conservative or surgical, were documented.

**Statistical Analysis:** The collected data were entered into Microsoft Excel and analyzed using appropriate statistical software such as SPSS. Descriptive statistics were used to summarize the data, with continuous variables expressed as mean and standard deviation, and categorical variables as frequencies and percentages. The diagnostic performance of ultrasonography was evaluated by calculating sensitivity, specificity, positive predictive value, and negative predictive value. The results were presented in the form of tables and charts for clear interpretation.

#### Result

Table 1 demonstrates the sensitivity and specificity of ultrasonography (USG) in diagnosing various diseases among 68 patients. USG showed very high diagnostic performance across most conditions, with 100% sensitivity and specificity in renal calculus (10/10), liver abscess (7/7), mesenteric lymphadenitis (5/5), acute pancreatitis (4/4), and ovarian cyst (3/3). In appendicitis, USG was helpful in 13 out of 14 cases, with a sensitivity of 92.85% and specificity of 100%. Similarly, in calculus cholecystitis, 10 out of 11 cases were correctly identified, showing 90.90% sensitivity and 100% specificity. The miscellaneous group had slightly lower accuracy, with 12 out of 14 cases correctly diagnosed, yielding a sensitivity of 85.71% and specificity of 97.00%. Overall, the table indicates that ultrasonography is a highly reliable diagnostic tool with excellent sensitivity and specificity for most abdominal conditions.

Disease	No. of Cases	No. of cases where USG was helpful	Sensitivity	Specificity
Appendicitis	14	13	92.85%	100%
Calculus Cholecystitis	11	10	90.90%	100%
Renal Calculus	10	10	100%	100%
Liver Abscess	7	7	100%	100%
Mesenteric Lymphadenitis	5	5	100%	100%
Acute Pancreatitis	4	4	100%	100%
Ovarian Cyst	3	3	100%	100%
Miscellaneous	14	12	85.71%	97.00%

Table 2 presents the overall diagnostic accuracy of ultrasonography (USG) in 68 patients with acute abdominal conditions. USG was diagnostic in 52 cases (76.47%), demonstrating its effectiveness as a primary imaging modality. In 3 patients (4.41%), the findings were mis-diagnostic, indicating a small

margin of error. Additionally, 13 cases (19.12%) required further investigations, suggesting that while USG is highly useful, nearly one-fifth of patients needed additional diagnostic support. Overall, the table highlights the strong diagnostic value of ultrasonography with some limitations

USG Findings	No. of Patients	Percentage
Diagnostic	52	76.47%
Mis-diagnostic	3	4.41%
Other investigations required	13	19.12%

Table 3 shows the distribution of patients based on the type of management among 68 cases. The majority of patients, 40 (58.82%), were managed conservatively, indicating that non-surgical treatment was sufficient in most cases. Meanwhile,

28 patients (41.18%) required surgical intervention. This suggests that although conservative management was more common, a substantial proportion of patients still needed surgery for definitive treatment.

Management Type	No. of Patients	Percentage
Conservative	40	58.82%
Surgical	28	41.18%

Table 4 illustrates the correlation between ultrasonographic (USG) diagnosis and the final diagnosis in 68 patients. The majority of cases were true positives, with 52 patients (76.47%), indicating a high level of accuracy of USG in correctly identifying the condition. A small proportion of cases, 3 patients (4.41%), were false positives,

where USG findings did not match the final diagnosis. Additionally, 13 cases (19.12%) were inconclusive, showing that in nearly one-fifth of patients, USG could not provide a definitive result. Overall, the table suggests that ultrasonography is a reliable diagnostic tool, though some limitations remain in terms of inconclusive outcomes.

Outcome	No. of Patients	Percentage
True Positive	52	76.47%
False Positive	3	4.41%
Inconclusive	13	19.12%

Table 5 presents the age and gender distribution of the 68 patients in the study. The majority of patients were in the 21–40 years age group (24 patients, 35.29%), followed by those aged 41–60 years (20 patients, 29.41%). The 1–20 years and 61–80 years groups each comprised 12 patients (17.65% each).

In terms of gender, males were more prevalent with 38 patients (55.88%), while females accounted for 30 patients (44.12%). This indicates a higher representation of young to middle-aged adults and a slight male predominance in the study population.

Variable	Category	No. of Patients	Percentage
Age Group	1–20 years	12	17.65%
	21–40 years	24	35.29%
	41–60 years	20	29.41%
	61–80 years	12	17.65%
Gender	Male	38	55.88%
	Female	30	44.12%

Table 6 shows the role of ultrasonography (USG) in clinical decision-making among 68 patients. USG confirmed the clinical diagnosis in 40 patients (58.82%), indicating it was most commonly used as a supportive diagnostic tool. In 12 patients (17.65%), it helped in narrowing down differential diagnoses, while in 10 cases (14.71%), it led to a

change in the initial diagnosis, highlighting its impact on clinical judgment. However, in 6 patients (8.82%), USG did not make any significant contribution. Overall, the table demonstrates that ultrasonography played a crucial role in the majority of cases, either by confirming or refining diagnoses.

**Table 6: Role of Ultrasonography in Clinical Decision Making (N = 68)**

Role of USG	No. of Patients	Percentage
Confirmed clinical diagnosis	40	58.82%
Changed diagnosis	10	14.71%
Helped in differential diagnosis	12	17.65%
No significant contribution	6	8.82%

### Discussion

The results of the current study greatly support the developed role of ultrasonography as a health-strong and dependable diagnostic tool in acute abdominal cases. High sensitivity and specificity, especially 100% in such conditions as liver abscess, renal calculus, mesenteric lymphadenitis, acute pancreatitis, and ovarian cysts are also similar to previous studies that emphasize the diagnostic potential of ultrasonography in organ-specific pathologies. As an example, Manfredi et al., (2001) [8] found that ultrasonography is an outstanding first-line screening modality in acute pancreatitis, particularly in mild and biliary-related cases, but computer tomography is necessary in more acute cases. This is consistent with our results, in which ultrasonography was proven with 100 per cent diagnostic accuracy in pancreatic diseases, which justifies its use as a primary investigation”.

Equally, the current research article had a high sensitivity level (92.85), and a high specificity level (100), respectively, which is similar to the results reported by Mishra et al., (2003) [9] who recorded a sensitivity level of 91.6 and a specificity level of 97, respectively. Nevertheless, close to lower values were found in studies like that by Al-Ajerami (2012) [10] which sensitivity and specificity were 84.8% and 83.3 and Zoller et al., (1996) [11] where the sensitivity and specificity were 85% and 96%. The differences can be explained by the differences in operator experience, number of patients served, and the study design. However, the high level of diagnostic accuracy, which the current study is no different, highlights the accuracy of ultrasonography in appendicitis.

Our study showed the sensitivity of the calculus cholecystitis in biliary tract diseases of 90.90 and the specificity of 100% that is closely similar to calculus cholecystitis which was reported to have sensitivity of 94% and specificity of 99% by Allemann et al., (1999) [12]. The above similarity reflects the strength of ultrasonography in assessing the pathology of the gallbladder. Nonetheless, the rare instances of diagnostic mistakes observed in the present as well as the prior study, including the inability to interpret a common bile duct stone, imply that ultrasonography is an extremely accurate technique but still may be problematic with relation to some complicated or unusual manifestations.

The final diagnostic performance of the ultrasonography in our study with definitive diagnosis of 76.47 percent of all cases is similar to the diagnostic accuracy rates in the study by Allemann et al., (1999) [12] where the correct diagnosis rates were between 70 percent and 83 percent. This is yet another similarity to confirm that ultrasonography is effective in normal clinical practice. In addition, the low rate of misdiagnosis 4.41% in our study indicates its high specificity and this is very important in preventing unnecessary interventions. The 19.12% of cases needing further investigations, however, points to the possibility of ultrasonography not being enough as a single modality which, of course, is highly valuable, but some of the cases might be ambiguous or complicated.

The applicability of ultrasonography in clinical decision-making, which was noted in the current research, is also similar to past works. Our research indicated that ultrasonography validated the initial clinical diagnosis of 58.82 percent of patients and changed the diagnosis in 14.71 percent of them which showed that ultrasonography has a considerable influence on the treatment of patients. This can be compared to the classification offered by Caterino et al., (1995) [13] where ultrasonography either validated or altered or even came up with new diagnosis of various patient's groups. The resemblance of these results highlights the need to consider ultrasonography as a diagnostic instrument and an indicator of the therapeutic decisions.

Moreover, the large percentage of patients who are treated with conservatory management (58.82) in our study is an indication of the capability of ultrasonography in the accurate detection of the conditions that do not need surgical intervention. This fact can be reinforced by McGrath and Keeling, (1991) [14] who highlighted how early ultrasonography is useful in detecting the presence of gynecological as well as other non-surgical causes of acute abdomen, thus saving unnecessary surgeries. This conservative approach is further confirmed by the fact that the correct diagnosis of the conditions, including mesenteric lymphadenitis and ovarian cysts, was achieved in our study, and the modality can help avoid overtreatment.

Conversely, the slightly reduced sensitivity of the miscellaneous conditions (85.71) in our research shows that ultrasonography might be limited in

diagnosing less distinctive or that are fewer common conditions. Such a result is in line with some general observations in the literature that ultrasonography is operator-dependent and might not be effective in situations with non-specific clinical presentation or in patients with either excessive bowel gas or obesity (Stoker et al., 2009) [15]. This is the reason why inconclusive cases (19.12) were high in our study and why supplementary imaging modalities should be considered in the selected patients.

The age brackets that the current study uses, i.e. a majority of patients in the 21- 40 years and a slight predominance by the males are consistent with the general epidemiology trends of acute abdominal conditions that have been reported previously (Cartwright and Knudson, 2008) [16]. Demographic factors do not affect the accuracy of the diagnosis of ultrasonography directly, but they give significant clinical background to interpret the results and conduct management.

On the whole, the findings of the current study are quite similar to those, which are available in the literature as they confirm the fact ultrasonography is a high sensitivity, specificity, and clinically useful tool in assessment of acute abdomen. Even though slight differences of diagnostic accuracy can be found in separate studies, the general consensus is in favor of its employment as a first line method of imaging. Simultaneously, the necessity of closer research in a part of the population supports the significance of a multimodal diagnosis method, especially when it comes to more complicated or inconclusive cases.

### Conclusion

The present study concludes that ultrasonography is a highly reliable, non-invasive, and readily available imaging modality for evaluating patients with acute abdomen, demonstrating strong diagnostic performance across a wide range of conditions, particularly in hepatobiliary, renal, and gynecological pathologies. It plays a crucial role not only in confirming clinical diagnoses but also in refining or altering initial impressions and guiding differential diagnoses, thereby significantly influencing patient management decisions. Ultrasonography effectively aids in stratifying patients toward conservative or surgical treatment pathways, while maintaining a high level of diagnostic accuracy with minimal false interpretations. However, a subset of cases still requires additional investigations, indicating that ultrasonography is best utilized as a first-line tool in conjunction with clinical assessment and complementary imaging when necessary.

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