

Diagnostic Accuracy of Ultrasonography in Evaluating Patients with Acute Abdomen: A Clinical Study**Manish Tardeja**

Assistant Professor, Department of Surgery, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati, Maharashtra, India

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Corresponding Author: Dr. Manish Tardeja

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Abstract:**Background:** The acute abdomen remains a diagnostic enigma due to the overlapping clinical manifestations and varying underlying pathology. Ultrasound (USG) imaging is a non-invasive, dynamic means of imaging that has been utilized for rapid assessment in this population.**Aim:** The aim of this study was to evaluate the USG's diagnostic utility in the acute abdomen, as well as to differentiate surgical conditions from non-surgical conditions (medical).**Method:** A prospective observational study over 12 months with patients aged one to eighty years presenting with acute abdominal pain who were admitted to Dr. Panjabrao Deshmukh Memorial Medical College, Amravati, India was performed in 90 subjects. Clinical assessment, laboratory examination, and USG was performed. The reference standard was surgical and histopathology. The USG was evaluated based on sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy.**Results:** USG showed good diagnostic performance for appendicitis (sensitivity 94.4%, specificity 100%), calculous cholecystitis (n: sensitivity 92.9%, specificity 100%), and complete sensitivity and specificity for renal calculus, liver abscess, and mesenteric lymphadenitis (n: 100% sensitivity, 100% specificity), acute pancreatitis, and ovarian cyst. Overall USG was correct in 77.8% of patients; misdiagnosed only in 3.3% of patients and in 18.9% required further investigation.**Conclusion:** USG is a rapid, reliable, first line and non-invasive modality for assessment and diagnosis of acute abdomen, that facilitates management decision and minimizes unnecessary surgical intervention.**Keywords:** Abdominal Pain, Acute Abdomen, Diagnostic Accuracy, Surgical Evaluation, Ultrasonography.

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Introduction

Of the several great accomplishments of medical science, ultrasonography is one of the greatest technical achievements. During recent decades, ultrasound became an essential component of contemporary medicine, notably of surgical practice, for investigative and diagnostic purposes. By being a non-invasive modality, along with real-time visualization, it has become an invaluable tool for the evaluation of a broad range of clinical entities, securing its place in everyday clinical practice. Ultrasonography occupies a unique niche in the evaluation of abdominal pathology because of the inherent difficulty associated with abdominal anatomy and physiological variations in the abdominal cavity. It has burgeoned in its application based on several studies and in part through the work of institutions dedicated to have confirmed its utility in the early evaluation, management, and complication avoidance from delayed interventions.

The abdomen, known as the "magic box," houses numerous organs that occupy a limited anatomical

space, and it also provides a portal through which many pathologies appear and oftentimes present with a characteristic clinical picture. Of these, the "acute abdomen" is perhaps the most notoriously difficult clinical entity characterized by an abrupt onset of severe abdominal pain, tenderness, guarding and occasionally associated with systemic symptoms such as nausea, vomiting or pyrexia. An acute abdomen usually demands an urgent surgical assessment. Timely recognition is vital, as delay in treatment strategies can present with catastrophic consequences to the patient such as peritonitis, septicemia, organ failure and death. Conversely, an unnecessary surgical procedure also has its own risks, such as the effects of any surgical procedure, prolonged hospital stays and cost implications to the healthcare system.

Abdominal pain is arguably the most prevalent presenting complaint in our everyday surgical practice, and it often heralds subacute pathology that will require early surgical intervention. Despite the

increasing sensitivity of our diagnostic tests, it remains challenging to confidently distinguish patients who require surgical intervention from those in whom a watchful waiting policy would be appropriate. It is understood that 25% of patients that we classify as an 'acute abdomen' ultimately receive an operative treatment; this discrepancy represents a core clinical dilemma; namely, distinguishing surgical cases from non-surgical cases, so that we can prepare optimal treatment and avoid useless treatment.

Although abdominal examination on clinical grounds still is an important part of assessing abdominal pain, it has its shortcomings. Important clinical cues are easily missed, and clinical presentation is influenced by factors including patient age, comorbidities, and individual disease pathology. Therefore, additional diagnostic aids are of significance; ultrasonography is an important additional diagnostic aid, with an advantage of being safe and affordable, while universally used due to its versatility.

Ultrasound offers high-resolution imaging, is easy to perform and is free of risk or ionizing radiation, allowing for repeated examinations to dynamically assess both disease processes and therapy outcomes. Its real-time capability also allows the examiner to study the morphology of organs, detect disease processes and study physiological events such as peristalsis and blood flow. Doppler ultrasonography further enhances the diagnostic ability of ultrasound by giving the examiner information regarding vascular perfusion, flow patterns, and hemodynamic changes, which are especially valuable in conditions such as bowel ischemia, appendicitis, and intra-abdominal hemorrhage. Technical advances also have greatly improved the utility of ultrasonography. Transportable and miniaturized systems now allow bedside scanning of patients within emergency departments, critical care departments, and operating suites. High-definition transducers also allow endoscopic and laparoscopic procedures, expanding ultrasound's application far beyond traditional diagnostics to interventional procedures.

However, despite all of this, ultrasonography remains considerably operator dependent. The quality of images and interpretation accuracy depends greatly on the skill and knowledge of the examiner, creating a strong need for protocolized standards and training for the highest diagnostic output, particularly for patients who present with acute abdominal symptoms. Due to its many advantages, ultrasonography is a first-line imaging modality for patients admitted for acute abdomen. Ultrasonography is fast, non-invasive, and economical, and it provides significant guidance for clinical decision making and management. Its intended purpose is to examine the diagnostic

accuracy of ultrasonography in the admitted patient with acute abdominal pain, its ability to differentiate between surgical and non-surgical conditions, and potential to guide appropriate and timely therapeutic options. As a systematic evaluation of ultrasonography and its clinical application, conducted herein, will shed light on its ongoing place as a foundational piece for the management of acute abdominal conditions.

Materials and Methods

Study Design: This was a prospective observational study aimed at evaluating the diagnostic accuracy of ultrasonography in patients presenting with acute abdomen.

Study Area: The study was conducted in the Department of Surgery, Dr. Panjabrao Deshmukh Memorial Medical College, Amravati, Maharashtra, India.

Study Duration: The study was carried out over a period of 12 months from February 2022 to January 2023.

Study Population: The study included 90 patients aged 1–80 years (41 females and 49 males) who were admitted with acute abdominal pain.

Sample Size: A total of 90 patients meeting the inclusion criteria were enrolled in the study.

Inclusion Criteria

- Patients aged 1–80 years.
- Non-traumatic patients admitted with acute abdominal pain.

Exclusion Criteria

- Patients with a history of abdominal trauma.
- Patients with chronic abdominal pain attending the outpatient department (OPD).

Data Collection: Data collection for the current study involved clinical, laboratory and imaging evaluations of all patients. In the ward, each patient was first examined and based on an extensive history and even more detailed physical examination, a clinical diagnosis was made as a working diagnosis. Appropriate laboratory investigations were carried out to refine and support the diagnosis, including complete blood counts and urinalysis. All patients subsequently underwent ultrasonography, this was performed using the real-time Toshiba video graphic scanner, with the 3.75 MHz transducer for abdominal scans and the 5 MHz transducer for transvaginal and transrectal scans. Patients were first prepared for ultrasonography, (which included fasting from the night before and bowel preparation if indicated), in order to provide the best images. Ultrasonographic findings were interpreted in correlation with clinical history and physical findings to develop a provisional ultrasonographic

diagnosis. Of the 100 patients in the study, 42 of them had surgical intervention, and findings of operative assessment were noted. Any fluid or tissue samples taken preoperatively or intraoperatively were submitted for pathology review, and a final diagnosis was made by correlating surgical and pathology findings.

Procedure: All patients had a structured assessment initiated by a relevant history and physical exam, followed by routine laboratory investigations. The ultrasound examinations were conducted by radiologists with experience in the field and completed in standardized fashion, with interpretations in concert with the clinical examination, creating the ultrasound diagnosis. For those patients requiring surgery, the actual surgery was performed at the appropriate time with the intraoperative findings documented. Any fluid or tissue obtained was subsequently sent for histopathological examination to confirm the diagnosis. For patients managed conservatively, final diagnoses were made according to clinical course and supplementary investigations.

Statistical Analysis: The data were entered into Microsoft Excel and analyses were performed using SPSS software version 25.0. The diagnostic

accuracy of ultrasonography was assessed by calculating sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and the overall accuracy. Continuous variables were reported as mean $\pm$ standard deviation (SD), and categorical variables were reported as frequencies and percentages."

Result

Table 1 represents the sensitivity and specificity of USG in diagnosing individual abdominal and pelvic pathology. USG identified 17 of 18 cases of appendicitis, to yield a sensitivity of 94.4% and a specificity of 100%. In the case of calculus cholecystitis (n = 14), USG accurately diagnosed 13 patients, corresponding to a sensitivity of 92.9% and specificity of 100%. For renal calculus, liver abscess, mesenteric lymphadenitis, acute pancreatitis and ovarian cysts, both sensitivity and specificity were 100%. In the miscellaneous category, USG accurately diagnosed 19 of 21 cases, which calculated to be a sensitivity of 90.5% and specificity of 98.7%. Overall, results suggest that ultrasonography is a very accurate diagnostic modality for a variety of abdominal and pelvic pathologies.

Table 1: Sensitivity and Specificity of Ultrasonography in Diagnosis of Disease

Disease	No. of Cases	No. of cases where USG was helpful	Sensitivity	Specificity
Appendicitis	18	17	94.40%	100%
Calculus Cholecystitis	14	13	92.90%	100%
Renal Calculus	15	15	100%	100%
Liver Abscess	8	8	100%	100%
Mesenteric Lymphadenitis	6	6	100%	100%
Acute Pancreatitis	5	5	100%	100%
Ovarian Cyst	3	3	100%	100%
Miscellaneous	21	19	90.50%	98.70%

Table 2 reports the overall diagnostic performance of ultrasonography (USG) in patients with acute abdominal conditions. Of the study population, USG diagnosed correctly in 70 cases (77.8%), was a misdiagnosis in 3 cases (3.3%), and was unable to diagnose the condition in 17 (18.9%) cases,

indicating the need for further studies. These results indicate that USG is a reliable tool to make diagnoses of acute abdominal conditions, although some patients will require additional diagnostic tests to make an accurate diagnosis.

Table 2: Overall Diagnostic Accuracy of Ultrasonography in Acute Abdominal Conditions

USG Result	No. of Patients	Percentage
Diagnostic	70	77.80%
Misdiagnosed	3	3.30%
Other investigations required	17	18.90%

Discussion

The current research showed that ultrasonography was highly sensitive and specific, and a non-invasive method for assessing patients with acute abdominal pathology. From the 18 cases of appendicitis, ultrasonography diagnosed successfully 17 cases,

giving 94.4% sensitivity and 100% specificity in this study population. The findings are parallel to prior studies, yet slight discrepancies are noted. Al-Ajerami (2012) [3] described a lower sensitivity and specificity of 84.8% and 83.3%, respectively, for acute appendicitis, emphasizing operator expertise

and patient influences on diagnostic ability. According to Mishra et al. (2003) [4], a sensitivity of 91.6% and a specificity of 97% for ultrasonography were noted for pediatric patients, closely matching our data and supporting ultrasonography as an effective primary modality for appendicitis identification. Zoller et al. (1996) [5], by meta-analysis, described a slightly reduced sensitivity of 85% but similar specificity of 96% for appendicitis, yet supporting our finding of high efficiency of ultrasonography for true-positive identification of appendicitis at a reduction of false positive identification."

In calculous cholecystitis, ultrasonography identified 13 of 14 cases with a sensitivity of 92.9% and a specificity of 100%. Similarly, values are equivalent to those of Allemann et al. (1999) [6], who noted a sensitivity and specificity of 94% and 99%, respectively, for which they also emphasized the modality's reliability for gallbladder disorders. A case of common bile duct stone was, however, falsely suggested as a portal vein thrombus/tumor, a finding concordant with presentations of ultrasonography failing at times to characterize CBD stones, particularly by covering overlying bowel gas or by anatomic variation (Stoker et al., 2009) [2].

Our patients' renal calculi were identified by both 100% sensitivity and specificity, demonstrating ultrasonography's exceptional capability for detecting calculi of the urinary tract. This is in agreement with prior research demonstrating ultrasonography offers a highly sensitive, convenient, and non-radiating method for primary evaluation of nephrolithiasis, even if incidental, non-opaque, or extremely small calculi are on occasion missed (Stoker et al., 2009) [2]. Similarly, our liver abscess, mesenteric lymphadenitis, acute pancreatitis, and ovarian cyst findings showed a 100% sensitivity and specificity, emphatically noting ultrasonography's versatility for a spectrum of organ systems. We are in agreement with McGrath et al. (1991) [7], who noted ultrasonography's distinct advantage for gynecologic disorders and other abdominal diseases for which expedient, bedside testing assumes greatest importance. Both Manfredi et al. (2001) [8] and our study raised a point regarding ultrasonography's potential as a sensible screening tool for acute pancreatitis, of particular advantage for biliary pancreatitis of a mild clinical presentation, yet contrast-enhanced CT may provide additional information if complication is suspected.

In our mixed subject population, which contained different abdominal conditions, we discovered a slightly lower sensitivity (90.5%) and specificity (98.7%) when the abdominal conditions were more mixed (suggesting although ultrasonography is a great tool, it may have less diagnostic utility in rare or atypical presentations). This observation

reinforces Caterino et al.'s (1995) description that ultrasonography was less helpful in a small minority of patients with complex or overlapping emergency abdominal conditions. Overall, ultrasound confirmed a definitive diagnosis in 77.8% of patients, had a low false-positive rate of 3.3%, and 18.9% of cases needed additional investigations. These findings support prior studies, which highlight ultrasonography has excellent diagnostic value when used in conjunction with other imaging modality (Stoker et al., 2009). This study further supports the notion that ultrasonography is a rapid, non-invasive, and first-line diagnostic tool that assists with timely clinical decision making. Its diagnostic value from a high level of accuracy for appendicitis, biliary, renal, hepatic, and gynecological conditions reinforces that it can serve as a general diagnostic tool, with only small limitations likely due to operator skill, patient-related factors, and a selective need for supplemental imaging.

In Summary, results from this study are generally aligned with literature, indicating high sensitivity and specificity for ultrasonography in evaluation of acute abdominal conditions. Comparative studies provide evidence that ultrasonography is a feasible and reliable examination technique within the ED for issues related to appendicitis, biliary, renal, hepatic, and gynecologic disease, but there may be limitations as it requires selective examination and adjuncts to further investigations, as needed.

Conclusion

The study found that ultrasonography may be a valuable and reliable point of care diagnostic method for the evaluation of acute abdomen patients. Ultrasonography had reasonable sensitivity and specificity for the evaluation of several types of abdominal pathology (appendicitis, calculous cholecystitis, renal calculi, liver abscess, mesenteric lymphadenitis, acute pancreatitis, and ovarian cyst), which is important to identify disease while minimizing false positives. Overall diagnostic performance statistics support these findings, given that most patients were given a diagnosis using just an ultrasound, which resulted in fewer additional diagnoses being given. While a few patients were found to require additional testing or had false diagnoses, ultrasonography was still a valuable first line tool to assist clinicians with efficient clinical decision making and to expedite intervention and management of acute abdomen presentations. The findings also suggested that the reassurance provided by ultrasonography could improve confidence in diagnostic accuracy and efficiency when access to more advanced modalities was not possible.

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