

Original Research Article

ULTRASOUND AND PLAIN RADIOGRAPHY IN EVALUATION OF ACUTE ABDOMEN: A STUDY OF DIAGNOSTIC EFFICACY

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ABSTRACT

Background: Acute abdomen is a medical emergency with diverse etiologies requiring rapid diagnosis for timely intervention. Imaging plays a pivotal role, with ultrasonography (USG) and plain abdominal radiography (X-ray) being the most accessible first-line modalities in emergency settings. The objective is to evaluate and compare the diagnostic efficacy of ultrasonography and plain radiography in identifying the underlying causes of acute abdomen and to correlate imaging findings with clinical and surgical outcomes.

Materials and Methods: A hospital-based cross-sectional study was conducted over one year, including 200 patients aged 18–85 years presenting with features of acute abdomen. All patients underwent USG and plain radiography. Imaging findings were recorded and correlated with final diagnoses. Data were analyzed using SPSS version 23.0, with $p < 0.05$ considered statistically significant.

Results: USG demonstrated high diagnostic accuracy in detecting cholelithiasis (99.9%), appendicitis (90%), pancreatitis (92.8%), and abscesses (99.9%). X-ray was more effective in bowel obstruction (99.9%) and radiopaque calculi (99.9%). Both modalities showed complementary diagnostic value.

Conclusion: Ultrasonography and plain radiography serve as valuable complementary tools in evaluating acute abdomen. Integrating both enhances diagnostic precision and supports timely management in emergency care.

Keywords: Acute abdomen; Ultrasonography; Radiography; Diagnostic imaging; Abdominal emergencies.

INTRODUCTION

Acute abdomen is a common and often life-threatening emergency, characterized by sudden, severe abdominal pain requiring immediate clinical and radiological assessment to determine the underlying cause and guide prompt intervention.^[1] Given its wide differential diagnosis—including gastrointestinal perforation, bowel obstruction, urinary calculi, appendicitis, and gynecological emergencies—imaging plays a pivotal role in establishing an early and accurate diagnosis.^[2,3] Ultrasonography (USG) is frequently the first-line modality due to its non-invasive nature, bedside applicability, and absence of ionizing radiation. It allows dynamic evaluation of abdominal organs,

bowel peristalsis, free fluid, and vascular flow, making it especially useful in diagnosing appendicitis, biliary diseases, renal calculi, and other intra-abdominal pathologies.^[4,5] The graded-compression technique enhances its ability to localize pathology directly at the point of maximal tenderness, thereby improving diagnostic accuracy in real time.^[6]

Plain abdominal radiography (X-ray), though limited in soft-tissue detail, remains widely utilized due to its availability, speed, and utility in identifying bowel obstruction, pneumoperitoneum, and radiopaque calculi.^[7] It is particularly valuable in detecting multiple air-fluid levels and dilated bowel loops in suspected intestinal obstruction, as well as free intraperitoneal air in cases of visceral perforation.^[8]

Despite their routine use, the individual and comparative diagnostic value of ultrasound and plain radiography in acute abdomen remains unclear. We aim to assess their effectiveness in detecting specific conditions to aid timely diagnosis and improve emergency care outcomes.

Aim and Objectives

The aim of the study is “Ultrasound and plain radiography in evaluation of acute abdomen- A study of diagnostic efficacy”.

The Objectives include

- To identify the cause of acute abdomen with radiography and ultrasonography.
- To correlate the clinical/surgical findings with plain X-ray and ultrasonography findings in cases of acute abdomen.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Radiodiagnosis at Rohilkhand Medical College and Hospital, Bareilly, Uttar Pradesh, over a period of one year from 1st August 2023 to 31st July 2024. A total of 200 patients presenting with clinical features of acute abdomen were included in the study.

Ethical clearance was obtained from the Institutional Ethics Committee before commencing the study. Written informed consent was taken from all participants. Patients aged between 18 and 85 years, of both genders, who presented with symptoms of acute abdomen—with or without complications—were included. Patients who were critically ill and unable to cooperate were excluded from the study.

Each patient underwent a thorough clinical history and physical examination. Imaging investigations included plain abdominal radiography and ultrasonography. The plain radiographs were taken in anteroposterior (AP) erect view using a horizontal beam to include both domes of the diaphragm and the pelvis up to the symphysis pubis. Depending on clinical necessity, additional supine and left lateral decubitus views were obtained. Film sizes ranged from 8×10 inches to 14×17 inches based on patient build, with a focus-film distance of 90 cm and exposure parameters between 60–90 kVp.

Ultrasound examination of the abdomen and pelvis was performed with or without prior preparation, based on the clinical condition. Where feasible, patients were kept nil by mouth for at least four hours, particularly in cases requiring gallbladder evaluation. Ultrasound scanning was conducted using advanced diagnostic machines including Samsung HS70A, HS40, and V7, equipped with curvilinear (3.5–5 MHz) and linear (7–12 MHz) probes. Real-time scanning was carried out in supine or prone positions as required.

The imaging findings from both radiography and ultrasonography were systematically recorded and compared with clinical outcomes or surgical findings for diagnostic correlation. All data were entered in

Microsoft Excel and analyzed using SPSS version 23.0. Descriptive statistics such as mean, standard deviation, and proportions were computed. Appropriate statistical tests were applied based on the nature and distribution of the data. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In this study comprising 200 patients with acute abdomen, the majority of patients were aged 18–35 years (38.5%), followed by 36–49 years (32.5%), indicating a higher incidence in younger adults. Overall, males were more commonly affected (66%) than females (34%).

The most common causes of acute abdomen in this study were ureteric/renal/vesical calculi (32%), followed by cholelithiasis (25%) and intestinal obstruction (14%). Less frequent etiologies included liver abscess, pancreatitis, appendicitis, perforations, and rare conditions like psoas abscess and intussusception, as shown in [Table 1].

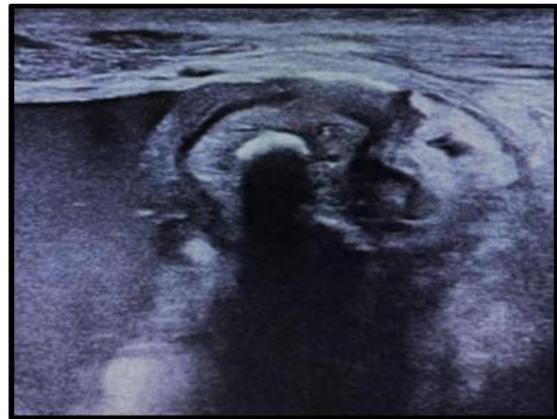


Figure 1: On USG whole abdomen, blind ending aperistaltic tubular structure with a hyperechoic focus within and surrounding inflammatory changes with free fluid with internal echoes is seen in the right iliac fossa region. Imaging features likely suggestive of appendicular perforation.



Figure 2: On USG whole abdomen, heterogeneous collection is seen in the right iliac fossa with adjacent fat stranding and probe tenderness, however, appendix could not be reliably visualised. Minimal free fluid with internal echoes is seen in the peritoneal cavity. Imaging features likely suggestive of appendicular perforation.



Figure 3: On USG whole abdomen images, liver parenchymal echotexture is inhomogeneous with a well defined heterogeneously hypoechoic subcapsular collection measuring 8.2 x 7.9 x 6.9 cm (volume~ 238 cc) is seen in segment VII of right lobe of liver. The features likely suggestive of hepatic abscess.



Figure 4: On USG whole abdomen images, gallbladder is well distended. Wall is thin. Lumen contains few high echogenic foci with posterior shadowing, largest measuring 8 mm. Imaging features likely suggestive of cholelithiasis.

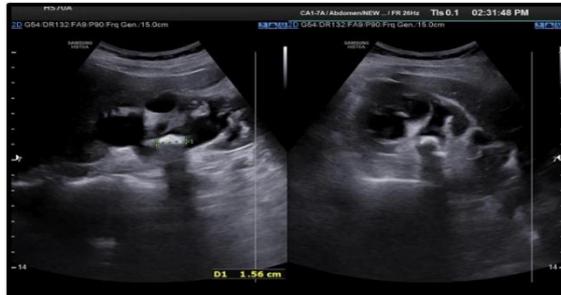


Figure 5: a. On ultrasound, Central pelvicalyceal system of right kidney appear moderately dilated with a high echogenic focus measuring 15.6 mm in right PUJ. b. On plain KUB x-rays film, there is an ill-defined radio-opacity noted in the right PUJ region. * Imaging features are likely suggestive of right PUJ calculus.



Figure 6: a. On ultrasound, bowel loops appear dilated (Largest diameter measuring~ 3.1 cm) with to and fro peristalsis. b. On abdominal x-ray film, few dilated gas filled loops of small bowel. The valvulae conniventes beautifully illustrated indicating it is small bowel. *Imaging features are likely suggestive of small bowel obstruction.





Figure 7: a. On ultrasound, bowel loops appear aperistaltic. Mild amount of free fluid with internal echoes is seen in the peritoneal cavity. b. On abdominal x-ray film, there is free gas under both domes of diaphragm. *Imaging features are likely suggestive of intestinal perforation.



Figure 8: On USG whole abdomen, blind ending non-compressible tubular structure likely appendix is visualized in right iliac fossa, measuring~ 7.5-8 mm in diameter with mild surrounding inflammatory changes. Imaging features likely suggestive of appendicitis.



Figure 9: On USG whole abdomen, short segment of bowel loop appear within the other part of bowel loop (giving target sign) is seen in right iliac fossa. There is no dilatation of proximal bowel loop and with normal peristalsis of proximal bowel loops. No lead point is seen. Imaging features likely suggestive of transient intussusception.

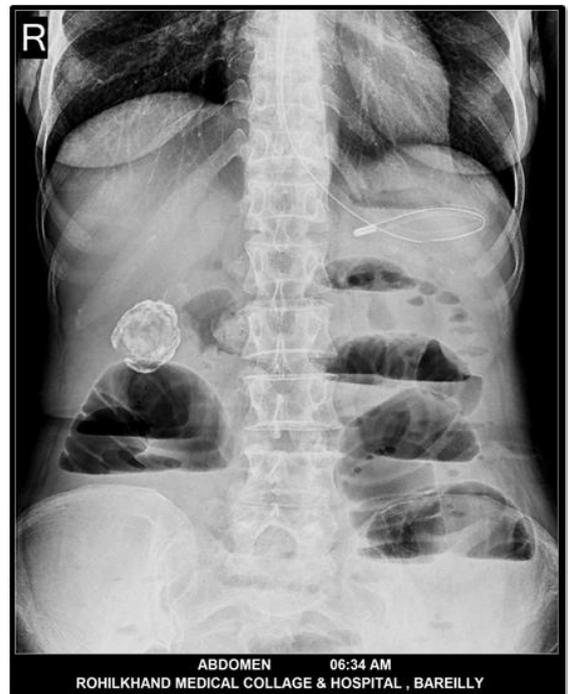


Figure 10: On x-ray abdomen erect film, multiple air fluid levels are seen, likely suggestive of intestinal obstruction. Also, there is calcified opacity in right upper quadrant (likely cholelithiasis) as an incidental finding.

Table 1: Causes of Acute Abdomen.

Causes	No. of Cases	Percentage
Acute ureteric/renal/vesical calculi	64	32%
Cholelithiasis	50	25%
Intestinal obstructions	28	14%
Liver abscess	17	8.5%
Acute pancreatitis	14	7%
Acute appendicitis	10	5%
Intestinal perforation	8	4%
Appendicular perforation	5	2.5%
Psoas abscess	2	1%
Intussusception	2	1%
Total	200	100%

When comparing diagnostic performance, USG shows high diagnostic accuracy in soft-tissue and inflammatory conditions such as cholelithiasis (99.9%), hepatic abscess (99.9%), psoas abscess (99.9%), acute pancreatitis (92.8%), and acute appendicitis (90%), while plain X-ray showed limited

utility in these cases. In contrast, X-ray was more effective in detecting intestinal obstruction (99.9%) and renal tract calculi (99.9% across subtypes), highlighting its superiority in gas-related and calcific pathologies, as detailed in [Table 2].

Table 2: Comparative Diagnostic Performance of Ultrasonography and X-ray in Various Causes of Acute Abdomen.

Condition		USG Findings (n, %)	X-ray Findings (n, %)	Total Cases
Intestinal Obstruction	Small Bowel	12 (66.6%)	18 (99.9%)	18
	Large Bowel	10 (99.9%)	10 (99.9%)	10
	Intussusception	2 (99.9%)	1 (50%)	2
KUB Calculus	Renal	16 (80%)	20 (99.9%)	20
	PUJ	12 (50%)	24 (99.9%)	24
	Ureteric	2 (33.3%)	6 (99.9%)	6
	VUJ	9 (99.9%)	9 (99.9%)	9
	Vesical	5 (99.9%)	5 (99.9%)	5
Hollow Viscus Perforation	Intestinal	5 (62.5%)	8 (99.9%)	8
	Appendicular	5 (99.9%)	1 (20%)	5
Acute Appendicitis	Acute	9 (90%)	2 (20%)	10
Hepatobiliary System	Cholelithiasis	50 (99.9%)	4 (8%)	50
Acute Pancreatitis	Acute Pancreatitis	13 (92.8%)	4 (28.4%)	14
Hepatic Abscess	Hepatic Abscess	17 (99.9%)	0 (0%)	17
Psoas Abscess	Psoas Abscess	2 (99.9%)	1 (50%)	2

DISCUSSION

Over recent years, real-time ultrasonography has gained prominence in the evaluation of acute abdomen due to its non-invasive nature, bedside applicability, and superior soft-tissue resolution. However, plain abdominal radiography remains valuable, especially in detecting air-fluid levels, free intraperitoneal gas, and radiopaque calculi. In our study, plain X-ray demonstrated 99.9% diagnostic accuracy in cases of intestinal obstruction, while ultrasonography detected 78.5%, often limited by excessive bowel gas. Lakhota et al,^[9] reported 96.29% accuracy for X-ray and only 50% for USG in similar settings. Sharma P,^[10] found diagnostic yield of 90.9% with X-ray and 72.7% with USG for bowel obstruction. In renal and ureteric calculi, X-ray again performed better, identifying 99.9% of cases, whereas USG detected 68.7%. Krishnappa H,^[11] (2019) reported 82.8% diagnostic success with USG and 74.2% with X-ray in urolithiasis. For intestinal and appendicular perforations, X-ray was diagnostic in 99.9% and 20% of cases respectively, while USG detected 62.5% and 99.9% respectively. Lakhota et al,^[9] noted 100% sensitivity of X-ray in intestinal perforation and 84.6% for USG, while Gathwal

CK,^[12] observed 100% accuracy with USG and none with X-ray in appendicular perforation. In hepatobiliary cases, particularly cholelithiasis, USG detected 100% of cases in our study, while X-ray identified only 8%. Similar findings were reported by Gathwal CK,^[12] who observed 100% accuracy with USG and none with X-ray, and Sharma P,^[13] who noted very low X-ray sensitivity due to radiolucent cholesterol stones. In acute pancreatitis, USG diagnosed 92.8% of cases by visualizing an enlarged hypoechoic pancreas with peripancreatic collection, while X-ray provided nonspecific signs in 28.4%. Gathwal CK,^[12] reported 85.7% sensitivity of USG and no diagnostic yield from X-ray. In suspected appendicitis, USG showed a diagnostic accuracy of 90%, with findings such as non-compressible, dilated appendix, while X-ray identified only 20% with non-specific signs like sentinel loop or appendicolith. These observations were in line with Gathwal CK,^[12] who found 90% USG accuracy and no utility of X-ray. Furthermore, in our study, USG successfully identified 99.9% of hepatic and psoas abscesses, while X-ray was non-contributory or limited. Gathwal,^[12] also reported 100% sensitivity with USG and none with X-ray in detecting such abscesses. Taken together, these findings underscore that ultrasonography is superior in evaluating soft-tissue

and inflammatory conditions, while X-ray retains value in detecting obstruction and calcific pathologies. The integration of both modalities enhances diagnostic efficiency in acute abdomen evaluation.

CONCLUSION

Ultrasonography and plain radiography serve as essential, complementary tools in evaluating acute abdomen. While USG excels in detecting soft-tissue and inflammatory conditions, X-ray remains superior in diagnosing obstruction and calcific pathology. Combining both modalities enhances diagnostic accuracy, speeds clinical decision-making, and improves patient outcomes, particularly in resource-constrained emergency settings.

Strengths of the Study

The study utilized a sizeable, well-defined sample with standardized imaging protocols and real-time correlation with clinical and surgical outcomes. Comparative evaluation of two frontline diagnostic tools across multiple abdominal emergencies offers practical insights for clinicians and supports evidence-based emergency imaging strategies.

Limitations of the Study

Being a single-center study, findings may not be fully generalizable. Operator dependence in ultrasonography and the limited specificity of plain radiography may have influenced diagnostic variability. Advanced imaging modalities like CT were not used for comparison, potentially affecting overall sensitivity benchmarks.

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