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Assessment of the Impact of Early Point-of-Care Ultrasound in Diagnosing Acute Abdominal Pain in the Emergency Department

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ABSTRACT

Acute abdominal pain is a common presenting complaint in the emergency department (ED), posing diagnostic challenges. Point-of-care ultrasound (POCUS) is increasingly used as a rapid, non-invasive diagnostic tool that can facilitate early diagnosis and management decisions. To evaluate the impact of early POCUS in diagnosing acute abdominal pain in the ED and its influence on clinical outcomes, including time to diagnosis, management decisions and length of stay. A prospective observational study was conducted in the ED, involving 100 patients presenting with acute abdominal pain. Patients were divided into two groups: Group A received early POCUS in addition to standard clinical evaluation and Group B received standard clinical evaluation alone. Outcomes assessed included time to diagnosis, management changes, need for further imaging and length of stay. Early POCUS significantly reduced the time to diagnosis (mean 45 minutes vs. 95 minutes, $p<0.001$) and resulted in changes in management decisions in 35% of cases in Group A compared to 10% in Group B ($p<0.05$). The need for further imaging was lower in Group A (20% vs. 50%, $p<0.01$). Length of stay was shorter in the POCUS group (5.8±2.1 hours vs. 8.4±3.0 hours, $p<0.05$). Early POCUS is a valuable tool in the ED for diagnosing acute abdominal pain, significantly reducing time to diagnosis and length of stay and aiding in management decisions. Integration of POCUS in standard ED protocols is recommended.

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Key Words
Abdominal, observational, addition, evaluation

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INTRODUCTION

Acute abdominal pain is one of the most common and challenging presentations in the emergency department (ED)[1]. It accounts for approximately 5-10% of all ED visits and its causes range from benign to life-threatening conditions. Rapid and accurate diagnosis is critical to avoid delays in treatment that can result in significant morbidity and mortality[2]. Traditional diagnostic modalities, such as physical examination and laboratory tests, are often insufficient in pinpointing the exact cause of abdominal pain, leading to further investigations like computed tomography (CT) scans, which can be time-consuming and expensive[3].

Point-of-care ultrasound (POCUS) has emerged as a valuable tool in the initial assessment of acute abdominal pain[4]. It is a non-invasive, readily available and relatively inexpensive imaging modality that can be performed at the bedside by trained emergency physicians. POCUS can help in identifying a variety of abdominal conditions such as gallstones, hydronephrosis, free fluid in the abdomen and bowel obstructions, thereby expediting the diagnostic process and guiding clinical management[5].

Despite its potential benefits, the use of POCUS in the evaluation of acute abdominal pain is not universally adopted and its impact on clinical outcomes such as time to diagnosis, changes in management and patient length of stay remains under-explored. This study aims to assess the impact of early POCUS on these clinical outcomes in patients presenting with acute abdominal pain in the ED[6].

MATERIALS AND METHODS

Study Design: This was a prospective, observational study conducted over 12 months in the emergency department of a tertiary care hospital.

Study Population: A total of 100 patients aged 18 years and above presenting with acute abdominal pain were enrolled in the study. Patients were excluded if they had a known diagnosis related to abdominal pain, were pregnant, or had hemodynamic instability requiring immediate surgical intervention.

Group Allocation:

- **Group A:** 50 patients received early POCUS in addition to standard clinical evaluation.
- **Group B:** 50 patients received standard clinical evaluation alone, without early POCUS.

Data Collection: Data collected included demographic details, clinical history, physical examination findings, POCUS findings (for Group A), time to diagnosis, subsequent management decisions, need for additional imaging and length of ED stay.

Outcome Measures:

- **Primary Outcome:** Time to diagnosis (defined as the time from ED presentation to a definitive diagnosis being made).
- **Secondary Outcomes:** Changes in management decisions based on POCUS findings, need for additional imaging and total length of ED stay.

Statistical Analysis: Data were analyzed using SPSS version 23. Continuous variables were expressed as mean±standard deviation and compared using independent t-tests. Categorical variables were compared using chi-square tests. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

Table 1: Demographic Characteristics of Study Population

Variable	Group A (n=50)	Group B (n=50)	P-value
Mean Age (years)	45.2 ± 17.6	44.1 ± 16.8	0.72
Gender (M/F)	28/22	27/23	0.84
BMI (kg/m²)	26.3 ± 4.8	25.8 ± 5.2	0.65

Interpretation: The demographic characteristics were similar between the two groups, indicating successful randomization.

Table 2: Initial Clinical Presentation

Symptom	Group A (%)	Group B (%)	P-value
Right upper quadrant pain	35	32	0.77
Left lower quadrant pain	22	25	0.69
Epigastric pain	28	26	0.80
Diffuse abdominal pain	15	17	0.79

Interpretation: The initial clinical presentation of abdominal pain was comparable between the two groups.

Table 3: Diagnostic Findings of POCUS in Group A

Condition Identified	Number of Patients (n=50)	Percentage (%)
Cholelithiasis	10	20
Hydronephrosis	7	14
Free intraperitoneal fluid	5	10
Bowel obstruction	4	8
No abnormal findings	24	48

Interpretation: POCUS identified a wide range of conditions contributing to abdominal pain in Group A, with nearly half of the patients showing no abnormal findings.

Table 4: Time to Diagnosis

Group	Mean Time to Diagnosis (minutes)	Standard Deviation	P-value
Group A (POCUS)	45	20.4	<0.001*
Group B (Standard)	95	35.2	

*Statistically significant

Interpretation: The time to diagnosis was significantly shorter in the POCUS group compared to the standard evaluation group.

Table 5: Changes in Management Decisions Based on Initial Evaluation

Management Change	Group A (%)	Group B (%)	P-value
Early Surgical Referral	18	6	0.03*
Conservative Management	22	4	0.002*
Need for Additional Imaging	10	25	0.01*

*Statistically significant

Interpretation: POCUS led to significant changes in management decisions, including more early surgical referrals and reduced need for additional imaging.

Table 6: Need for Additional Imaging (CT/MRI)

Group	Number of Patients (%)	P-value
Group A (POCUS)	10 (20%)	0.01*
Group B (Standard)	25 (50%)	

*Statistically significant

Interpretation: Fewer patients in the POCUS group required additional imaging compared to the standard evaluation group.

Table 7: Length of Stay in the Emergency Department

Group	Mean Length of Stay (hours)	Standard Deviation	P-value
Group A (POCUS)	5.8	2.1	<0.01*
Group B (Standard)	8.4	3.0	

*Statistically significant

Interpretation: The use of POCUS significantly reduced the length of stay in the ED.

Table 8: Diagnostic Accuracy of POCUS vs. Standard Evaluation

Diagnostic Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	P-value
POCUS	85	95	92	88	<0.001*
Standard Evaluation	70	80	75	75	

*Statistically significant

Interpretation: POCUS had higher diagnostic accuracy compared to standard clinical evaluation alone.

Table 9: Patient Satisfaction Scores (Continued)

Group	Mean Satisfaction Score (1-10)	Standard Deviation	P-value
Group A (POCUS)	8.5	1.2	0.02*
Group B (Standard)	7.2	1.8	

*Statistically significant

Interpretation: Patients in the POCUS group reported significantly higher satisfaction scores compared to those in the standard evaluation group, reflecting a preference for the faster diagnostic process and reduced need for additional tests.

Table 10: Complications and Adverse Outcomes

Complication	Group A (n=50)	Group B (n=50)	P-value
Missed Diagnosis	1 (2%)	3 (6%)	0.30
Delayed Treatment	1 (2%)	4 (8%)	0.17
Need for Repeat ED Visit	2 (4%)	6 (12%)	0.14
Mortality	0 (0%)	0 (0%)	N/A

Interpretation: The incidence of complications and adverse outcomes was lower in the POCUS group, although the differences were not statistically significant.

Table 11: Diagnostic Yield of POCUS for Specific Conditions

Condition	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Cholelithiasis	95	98	94	98
Hydronephrosis	90	96	88	96
Bowel Obstruction	85	95	80	96
Free Intraperitoneal Fluid	80	100	100	95

Interpretation: POCUS demonstrated high sensitivity and specificity for identifying specific abdominal conditions, particularly for cholelithiasis and free intraperitoneal fluid.

Table 12: Impact of POCUS on Hospital Admission Rates

Group	Hospital Admission Rate (%)	P-value
Group A (POCUS)	35	0.04*
Group B (Standard)	50	

*Statistically significant

Interpretation: The use of POCUS was associated with a lower rate of hospital admissions compared to standard clinical evaluation, suggesting that POCUS can help identify patients who can be safely discharged from the ED.

This study demonstrates that the use of early point-of-care ultrasound (POCUS) in the evaluation of patients presenting with acute abdominal pain in the emergency department (ED) significantly improves clinical outcomes[7]. The integration of POCUS into the initial evaluation process resulted in a significant reduction in time to diagnosis, changes in management decisions and a decrease in the need for further imaging[8]. Additionally, the length of ED stay and hospital admission rates were significantly lower in the POCUS group compared to those who underwent standard evaluation alone[9].

The time to diagnosis was notably shorter in the POCUS group, with a mean difference of 50 minutes compared to the standard evaluation group[10]. This reduction in diagnostic time is critical in the ED setting, where timely decision-making can directly impact patient outcomes. By providing rapid and accurate identification of conditions such as cholelithiasis, hydronephrosis and bowel obstruction, POCUS allows for quicker initiation of appropriate treatments, including surgical consultation or conservative management[11,12].

Changes in management decisions were also more frequent in the POCUS group[12]. In 35% of cases, POCUS findings directly influenced the clinical management pathway, leading to early surgical referral or altered conservative management[13]. This is in stark contrast to the standard evaluation group, where only 10% of cases saw similar changes[14]. The ability of

POCUS to rule in or rule out significant pathology without the need for additional imaging not only expedites patient care but also reduces healthcare costs associated with unnecessary tests[15].

The reduction in the need for additional imaging, such as CT or MRI, further supports the utility of POCUS as an initial diagnostic tool[16]. Only 20% of patients in the POCUS group required further imaging compared to 50% in the standard evaluation group[17]. This finding is particularly important given the increasing concerns about radiation exposure and the potential for over-utilization of advanced imaging modalities in the ED[18].

The length of stay in the ED was significantly shorter for patients who received POCUS, with a mean reduction of approximately 2.6 hours. This not only improves patient satisfaction, as reflected in the higher satisfaction scores in the POCUS group, but also optimizes ED throughput, reducing overcrowding and improving overall department efficiency[19].

Patient satisfaction scores were significantly higher in the POCUS group, likely due to the faster diagnostic process and decreased need for further imaging or prolonged observation. Patients value prompt and clear communication about their condition and management plan, which POCUS facilitates by providing real-time visual information that can be shared with the patient at the bedside[20].

Despite these benefits, there are some limitations to the use of POCUS. Operator skill and experience play a significant role in the accuracy of POCUS findings and there is a learning curve associated with its use. Additionally, POCUS may not detect all abdominal pathologies, particularly in cases with poor acoustic windows or when subtle findings are present. This study also did not evaluate long-term outcomes or compare POCUS with other rapid imaging modalities such as focused assessment with sonography for trauma (FAST) or limited CT scans.

Future studies should focus on multicenter trials to validate these findings in diverse ED settings and evaluate the cost-effectiveness of integrating POCUS into standard diagnostic protocols for acute abdominal pain. The development of standardized training and certification programs for emergency physicians in the use of POCUS is also recommended to ensure consistent and high-quality care.

CONCLUSION

Early use of point-of-care ultrasound significantly improves the diagnostic process and clinical management of patients presenting with acute abdominal pain in the emergency department. It reduces time to diagnosis, decreases the need for further imaging, shortens ED stay and enhances patient satisfaction. POCUS should be considered as an integral part of the initial assessment of acute abdominal pain in the ED and its implementation in standard ED protocols is recommended.

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