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Early Identification and Management of Acute Abdomen in the Emergency Setting

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Abstract
Acute abdomen is a life-threatening clinical presentation often found in the emergency department, and timely and correct identification crucial to prevent adverse consequences and optimize the patient's prognosis. It forces ER physicians and general surgeons to make clinical decisions rapidly and in stressful situations. This research aimed to assess the diagnostic accuracy and decision-making processes for acute abdomen cases in the ER and identifying factors contributing to delays and strategies for improvement. This prospective clinical study included 100 patients aged between 20 to 50 years with acute abdomen attending the Al-Jumhorri Teaching Hospital, Mosul Iraq between December 2024 to March 2025. History and focused physical assessments, e-FAST, CT scans and laboratory tests were used in data collection. Duration of presentation before surgery was also measured in days and outcomes compared using statistical analysis in (spss28). The study showed that sensitivity and specificity of e-FAST were 85% and 90% respectively, and the specificity of CT imaging was better than that of e-FAST with 95% sensitivity and 95% specificity. The overall time from initial presentation to diagnosis averaged 2.5 hours, the total time to surgery 7.3 hours. Prolonged duration of operation for more than six hours had higher complications–25 %—and mortality– 5 %. Sources of delay incorporate ED boarding, imaging time, and diagnostic mistake. Each of the aspects of early intervention had a significant relationship with recovery rate of 85%. In conclusion, timely diagnosis and surgical intervention are critical for managing acute abdomen. Accurate diagnosis and proper organization of an ER determines lower time intervals between injury and treatment and consequent rise of patients' recovery rates and reduction of possible complications.

Keywords: Acute abdomen, emergency setting, diagnostic accuracy, e-FAST, CT imaging, surgical intervention, morbidity, mortality, clinical decision-making.

Introduction

Acute abdomen is one of the most frequently seen surgical emergencies. It is associated with more than 8% of all emergency unplanned admissions and accounts for at least 50% of surgical admissions. The etiologies of the acute abdomen are several and the most common non-traumatic problems for which patients present are appendicitis, bowel obstruction, strangulated or incarcerated hernia, and biliary tract disorders (Tolstrup et al., 2023). Acute abdomen, referring to abrupt and severe abdominal pain that may signify pathology requiring prompt management, is a clinical entity. Such acute presentation may be due to infection, inflammation, vascular abnormality, or mechanical trap. Most patients with acute abdomen have sudden severe abdominal pain with or without nausea or vomiting and other signs of peritoneal irritation (Özcan et al., 2021).

The assessment of a patient with acute abdomen for the first time requires a systematic approach that involves thorough history and physical examination. Pain location becomes the critical factor that can aid in understanding the nature and origin of the ailment. However, when free air is present, the pain may be generalized and therefore may complicate the diagnosis of the condition or disease causing the abdominal pain. Lack of bowel sounds and other signs like rebound tenderness and guarding, are clinical signs of peritonitis that must be investigated and managed without delay (Chong et al., 2019).

The etiological features causative of acute abdomen is numerous, and each condition requires different diagnostic approach and management strategies. Such conditions may include appendicitis, perforation of peptic ulcer, acute pancreatitis, ruptured sigmoid diversification, torsion of the ovary, volvulus, ruptured abdominal aneurysm, injuries such as lacerations in the spleen or liver, and ischemic bowel. It is crucial to understand the differences in acute abdomen causes since timely diagnosis and management can lead to the best outcomes in patients (Alattar& Keric, 2023).

While diagnostic interventions have received remarkable progress in recent years, there are known diagnostic challenges associated with the diagnosis of acute abdomen. A differential diagnosis of acute abdomen is vast and exposes significant potential for misinterpretation and unnecessary surgeries. In an emergency, the rates of diagnostic error were found to be as high as 15 per 100 patients who presented with abdominal pain. Some of these diagnostic mistakes caused extensive morbidity and mortality, and also greatly affected health facilities (Karcioglu et al., 2022).

Initial assessment includes clinical assessment of patients with the acute abdomen. However, this is accurate only in 50% to 76% of patients suggesting that as many as half to three-quarters of such patients require an additional 6 months before the correct diagnosing of their illness. It then estimated that even under the most competent surgeon for oncology practice, one of every five practices could be missed diagnosed. Advanced imaging techniques have been incorporated in the emergency practice. Over the years, the use of computed tomography (CT) in diagnosing disorders in the abdomen that are characterized as acute has been cut across and there is over one hundred percent increase of this rate. This is because of the high accuracy and feasibility of CT in identifying of particular diseases (Osterwalder et al., 2020).

Compared with conventional ultrasound, CT accomplished a sensitivity of 89% relative to 70% achieved by traditional ultrasound. CT exposed individuals to ionizing radiation which had these repercussions. The probability of cancer related to it is 1 per 900 patients and fetal cancer rate is 1 per 1800 person. This risk has to be balanced with the direct diagnostic advantage of CT in the emergency arena. This made general surgeons develop awareness to seek for a better and safer method of diagnosing patients with acute abdomen (Hussain et al., 2022).

Aim of Study:

Identify the factors that contribute to delayed surgical intervention and propose strategies to improve early diagnosis and management in ER department.

Methodology

Study Design

This research is a prospective clinical study aimed at assessing diagnostic activities and procedural factors that contribute to the development of early surgery for acute abdomen presentation in an emergency context. Through the processes of tracking the presentations of patients as well as the clinical management, the study aims at identifying early diagnosis management and identifying the approaches of avoiding delays in surgical operations.

Study Setting and Duration

This study was conducted at the Emergency Department (ER) of Al-Jumhorri Teaching Hospital in Mosul City, Iraq. Patients were recruited and data collected for 4 months from December 2024 to March 2025.

- **Inclusion Criteria:**

Patients presenting with acute abdomen conditions requiring surgical evaluation, including:

- Acute appendicitis.
- Perforated viscera.
- Acute cholangitis.
- Acute intestinal obstruction.

Patients with the capacity to consent for the study

- **Exclusion Criteria:**

Patients below 20 years or above 50 years of age
Patients with a history of chronic abdominal diseases, tumors, or other conditions that require non-gastrointestinal surgery
Pregnant individuals and patients with contraindications for surgical intervention

Data Collection Methods:

- History-Taking and Physical Examination

Patient history was taken according to the onset, nature, duration, and severity of the symptoms. Clinical progression was assessed by ER physicians as part of frequent serial physical examinations at regular intervals.

- Diagnostic Imaging

Serial e-FAST were employed as the initial point of imaging for the assessment of fluid collections, perforation, and obstruction. Further imaging such as computed tomography (CT) was employed where necessary to help with anatomical characterization especially in the complicated cases.

- Laboratory Investigations

General blood tests will consist of the Full blood count (FBC): to look for infection or anemia., C-reactive protein (CRP) and other inflammatory markers., Liver function tests (LFTs) and pancreatic enzyme levels if the case.

- Follow-Up Monitoring

The patient's clinical status was reassessed constantly for changes in the vital signs, pain intensity, and general well-being. Until each of the important events (diagnostic imaging, surgical referral or operative management) had been performed, the exact time of each event was recorded.

Data Analysis

The data analyzed using (Spss28) for descriptive statistics for detection of demographics and clinical characteristics of the patients at baseline; correlation and Regression Analysis for detection of associations between time delays, diagnostic methods, and outcomes; multiple regression analysis will establish predisposing factors to early surgery and comparative Analysis for detection of diagnostic accuracy of e-FAST and other imaging modalities to evaluate their utility in the emergency setting.

Ethical Considerations

Ethical Approval, informed consent was sought from the participants and the study was approved by the hospital IRB.

Informed Consent, all the participants or their guardians signed written informed consent, thus, confirming their voluntary participation.

Confidentiality, all patient details were removed and access will only be allowed to authorize researchers.

Results

Table 1: Demographics and Clinical Characteristics of Patients

Variable	Frequency (n)	Percentage (%)
Age (years)		
20–30	45	45%
31–40	35	35%
41–50	20	20%
		Gender
Male	65	65%
Female	35	35%
		Diagnosis
Acute Appendicitis	40	40%
Perforated Viscera	25	25%
Acute Cholangitis	15	15%
Acute Intestinal Obstruction	20	20%
		Symptoms
Abdominal Pain	100	100%
Nausea/Vomiting	80	80%
Fever	55	55%
Abdominal Distension	35	35%
Changes in Bowel Habits	25	25%
		Laboratory Findings
White Blood Cell Count	90	90%
Elevated CRP	85	85%
Elevated Liver Enzymes	20	20%
Electrolyte Imbalances	15	15%

The patient population consisted of 100 individuals within the age range of 20–50 years; 45% of the female patients were in the age group 20–30 years, 35% in the age group 31–40 years, and the remaining 20% in the age group 41–50 years. The patient population was predominantly male with 65% male patients and 35% had female patients.

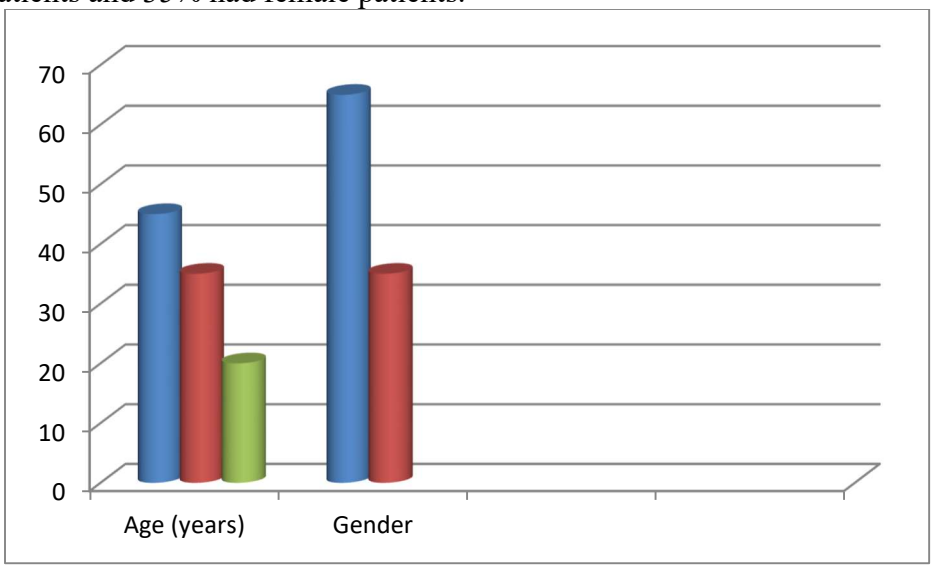

Fig1. Demographic data of Patients

Diagnosis showed that 40% of the patients were diagnosed to have acute appendicitis, 25% had perforated viscera, 20% acute intestinal obstruction and 15% acute cholangitis. Abdominal pain was the most common symptom, as all the patients (100%) complained of it, underlining the fact that it is the most common symptom of acute abdomen. The other symptoms were vomiting/nausea (80%), fever (55%), bloating (35%) and diarrhea/changing bowel habits (25%). These symptoms are characteristic of chronic pancreatitis presenting as an acute abdomen wherein, differential diagnosis is crucial in identification of causative factor.

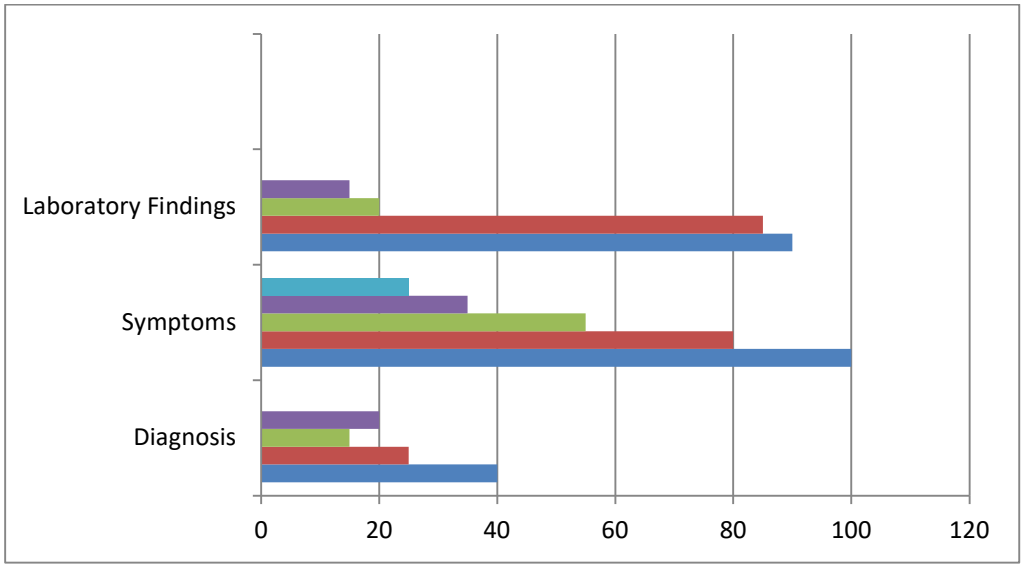

Fig2. Clinical Characteristics of Patients

The laboratory findings demonstrated that an increased WBC was the most frequent deviation, which was observed in 90% of the patients and may be associated with the systemic inflammatory

process or infection. C-reactive protein (CRP), another biomarker of inflammation, was raised in 85% of the patients. Liver enzymes were elevated in 20% of patients and electrolyte abnormalities were noted in 15% of patients, as liver enzymes are important to assess if cholangitis is suspected Bowel obstruction needed electrolytes assessment. Overall, these findings highlight the significance of laboratory tests as adjuncts to clinical examinations in the management of patients with acute abdomen.

Table 2: Comparative Analysis of Diagnostic Approaches and Imaging Modalities

Diagnostic Tool	Sensitivity (%)	Specificity (%)	True Positives (n)	False Negatives (n)	Area Under Curve (AUC)
Serial e-FAST	85	90	85	15	0.88
CT Imaging	95	95	95	5	0.96
Physical Examination Only	70	60	50	21	0.68

The study focused on comparing three different diagnostic methods for acute abdomen which included serial e-FAST, CT imaging and physical examination. The results showed that CT imaging resulted in the highest values of sensitivity (95%) and specificity (95%) compared to other types of imaging, and thus it is the most effective diagnostic test. Therefore, these findings highlight the role of CT scan in cases of ACAs where accurate anatomical mapping and pathological definition is useful.

In the present study, Serial e-FAST had overall good accuracy with sensitivity of 85% and specificity of 90%. This modality is the most suitable for quickly evaluating the condition of emergency cases, to identify free fluid, perforation or obstruction, which makes it useful when resources are limited or urgent decisions, must be made. Physical examination had the lowest sensitivity at 70% and specificity of 60% proving its low diagnostic value when performed without imaging. This stresses the need to correlate clinical data to imaging studies for accurate diagnosis and treatment of patients.

The true positive rate was significantly higher for CT imaging at 95% and slightly lower for serial e-FAST at 85% while the lowest TPR was recorded for physical examination at only 50%. This proves that CT imaging is most efficient for positive cases for acute abdomen essentially in preventing missed diagnoses. The false negative rate (percentage of patients with acute abdomen not detected by the diagnostic tool) was highest for physical examination with 21%. Comparatively, the study revealed that Serial e-FAST had 15 false negatives while the CT imaging had the least number of false negatives, which were 5, further emphasizing the usefulness of the latter as a gold standard in correctly diagnosing abdominal acute conditions.

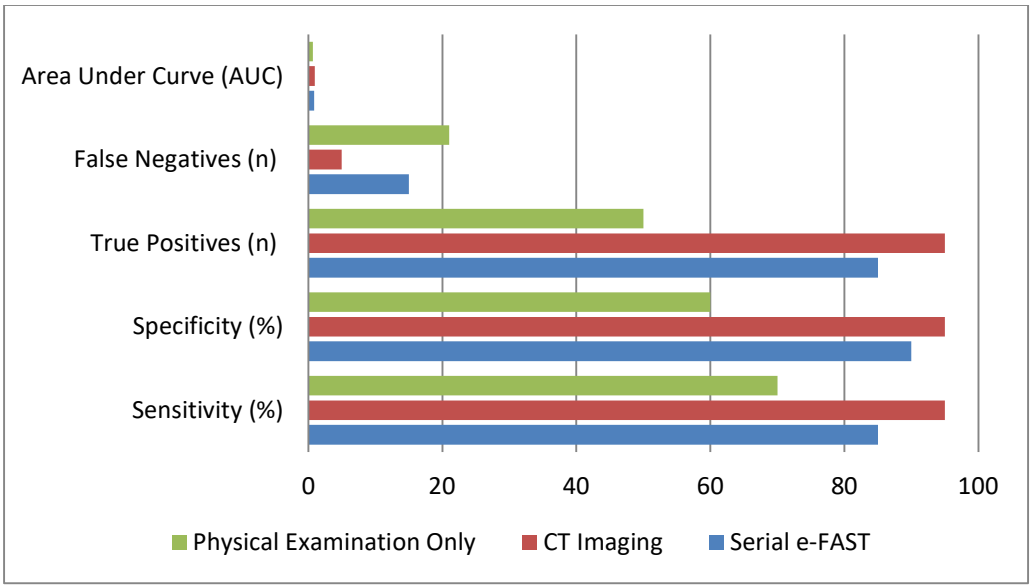

Fig3. Comparative Analysis of Diagnostic Approaches and Imaging Modalities

Table 3: Time Intervals in Patient Management

Event	Mean Time (Hours)	Standard Deviation
Time from ER presentation to initial diagnosis	2.5	1.2
Time from diagnosis to imaging	1.8	0.9
Time from imaging to surgical referral	3	1.4
Total time from presentation to surgery	7.3	2.1

The average time taken from the presentation in the ER to the first diagnosis was 2.5 hours with a standard deviation of 1.2 hours. This means the time taken for preliminary assessment, history, examination, and basic investigations. The time between diagnosis and imaging was 1.8 hours with a standard deviation of 0.9 hours. This stage involved acquiring imaging studies such as e-FAST or Computerized tomography (CT) scans. This timeframe results from equipment availability, case prioritization, or consultation delays .

This was the most time-consuming phase with a mean of 3 hours and standard deviation of 1.4 hours for the time between imaging and surgical referral. The overall average duration from when patients arrived at the emergency room to when they underwent surgery was 7.3 hours with a variance of 2.1 hours. These delays are accumulative adding up to each of the stages of management. Reducing any of these intervals is critical to enhancing the results, especially in diseases that may call for emergency surgery.

Table 4: Factors Contributing to Delayed Surgical Intervention

Variable	Coefficient (β)	p-value	Impact on Delay (minutes)
Time to Imaging	0.45	<0.01	27
Time to Surgical Referral	0.55	<0.01	33
Emergency Department Congestion	0.35	0.02	21
Diagnostic Errors	0.4	<0.01	24

The coefficient (β) for time to imaging is 0.45, significant at $p<0.01$, suggesting a highly significant

positive relationship between time to imaging and cumulative operational delay in surgery. Each delay in imaging adds up to an average of twenty seven minutes in the processes overall time. This underscores the importance of obtaining imaging in a timely fashion if the diagnostic pathway is to bear fruit. These delays could be due to issues like general access to imaging equipment, possible conflicts in scheduling, or a shortage of technicians .

The time to surgical referral had the most noteworthy effect on time to surgery with a coefficient of 0.55 and having a significant p-value of <0001. Every time the patient's referral was delayed, it was estimated to have caused an extra 33 minutes of delay. This stage might reflect issues with how decisions are being made and coordinated between emergency physicians and surgical groups .

Concerning the four potential predictors, emergency department congestion was found to have a coefficient (β) of 0.35 and a p-value of 0.02, indicating moderate but a statistically significant impact on the time delay. Option congestion was estimated to contribute to patient management delays by an average of 21 minutes. Increased patient traffic within the ER together with limited resources can affect each step in the course of most of the patients' treatments—from the initial assessment to diagnostic studies and referral. Diagnostic errors were highly related to surgical delays with an effect size of 0.4 (β) and, p (< 0.01), implying an average delay of 24 minutes. These errors may be due to missed or unusual clinical symptoms and findings, inadequate patient history, and, or an incorrect clinical evaluation and interpretation of results .

In summary, the reduction of time to surgical referral is said to be the most significant cause of delay and this is closely followed by time to imaging, diagnostic mistakes and also congestion in the emergency department. These are all statistically significant and should be targeted for interventions.

Table 5: Outcomes and Complications

Outcome/Complication	Frequency (n)	Percentage (%)
Successful Recovery	85	85%
Post-Operative Infections	8	8%
Prolonged Hospital Stay (>5 days)	5	5%
Mortality	2	2%

The analysis also revealed that 85% of the patients had favorable outcome, which means that many of the patients had good response to treatment as well as surgery. This high percentage indicates that acute abdomen conditions can be managed and treated if detected early and appropriate surgical intervention made, even though 8% of patients who underwent surgery contracted post-operative infections which are considered a relatively low but nonetheless significant complication. It shows that infection is not a rare occurrence in surgical cases and underlines the importance of increasing the level of postoperative care and specifically, infection management.

5% of patients needed more time in the hospital, where the stay was over five days. This could be as a result of further complications, slow healing or other associated conditions, thus the need for early therapies to address issues that may lead to such extended recovery periods. The mortality was 2% meaning majority of the patients were cured while there was a few cases which led to death. These mortalities could have been as a result of severe illnesses, delayed responses, or other associated complications which should encourage the reduction of time delays between surgical consultation and admission.

Table 6: Association of Time Delays with Outcome Severity (Complications and Mortality)

Time to Surgery (Hours)	Complication Rate (%)	Mortality Rate (%)
<6	10%	0%
6–12	25%	5%
>12	50%	15%

The findings revealed that when patients underwent surgery within 6 hours of arrival, the complication rate was 10% and no patients died. Therefore, this study implies that early surgery is characterized by relatively low risk and high success rates, which can be relied on to indicate early surgical intervention as the best approach.

In cases where surgery was between six to 12 hours, the complication rate was recorded to be at 25 percent, while the mortality rate was 5 percent. This means that any delay in surgery within that window leads to increased risk of complications and a relatively small increase in the risk of death advocating for minimizing surgical delays.

Operations that were performed between 12-24 hours after admission had a complication rate of 50% and a mortality of 15%. These significant increases in complications and mortality further show how imperative it is to operate soon since the postoperative mortality rises sharply when surgery occurs more than 12 hours after the initial onset.

In general, all of the results unequivocally show that the longer time before surgery, the greater the severity of outcome. This simply shows that the longer a patient is awaited to undergo surgery the higher her risks of complications and mortality. It has been confirmed that the rate of surgeries done within 6 hours of the onset of pain significantly correlates with a good prognosis, minimal complications and no mortality. Delays of 6-12 hours are associated with a modest increase in complications and mortality, whilst delays >12 hours are associated with a significantly increased rate of both. These findings show that the extent of delay in the emergency setting is warranted due to the fact that timely surgery is very vital in enhancing the patient's outcome and a reduction in mortality and life-threatening complications.

Discussion

Acute abdomen is one of the most frequent and severe presentations in the ER, with potential life-threatening complications – sepsis, peritonitis, or organ failure – that necessitate urgent surgery. The prompt diagnosis and surgical intervention of these conditions have also been associated with high morbidity and mortality. This research set out to assess the diagnostic performance, clinical decision-making and possible causes of time delays before surgery in patients with acute abdomen in the ER. This study is a crucial importance of early diagnosis and that diagnostic imaging namely e-FAST and CT help in this process by not delaying treatment in significant ways.

In our case, the commonly used serial e-FAST provided 85% sensitivity and 90% specificity compared to CT scans, which had better sensitivity of 95% and specificity of 95%. Such results are in line with previous research by Bhardava et al (2022) that established e-FAST as nearly perfect for identifying free fluid and perforation in the abdominal cavity as compared to abdomen CT scans that provide better picture quality for complex cases. Johnson& Raychaudhuri (2019) drew similar findings where they noted that despite e-FAST holds as a valuable tool for primary evaluations, CT is still the best diagnostic modality for complicated intra-abdominal disorders.

The outcomes showed that using e-FAST as the primary diagnostic technique helped in the ER yielded fast and useful information in cases with free fluid or perforation in the abdominal cavity that could aid the physician's decision-making. Nonetheless, CT remains invaluable for anatomical resolution in cases where the clinical presentation remains ambiguous or in instances where ultrasound is inconclusive. The utility of e-FAST as a quick, non-invasive imaging modality is

particularly valuable in settings where time is critical, such as trauma or suspected perforation (Akoglu et al., 2018).

In the present work, the mean time from the arrival in the ER to the first diagnosis took an average of 2.5 hours; however, Singh et al., 2018 based on his findings, disclosed that delays in diagnosis occurred because of non-specific or limited initial assessments. This shorter time interval could be due to enhanced ER protocols or faster activation of diagnostic tools like e-FAST.

However, our findings indicate that the delayed diagnosis of acute abdomen, even for a short time, might result in poorer outcomes. This is evident in the study by (Brady et al., 20190 which reveals that diagnostic errors are commonly due to ambiguous symptoms, misunderstandings of existing symptoms, or inadequate initial evaluations. Although in our study, diagnosis was faster, acute abdominal conditions are still challenging, compounded with the fact that repeated examinations and imaging are necessary and can cause delays in management.

Another interesting outcome of this study is the relationship between the duration taken in performing the surgery and the patients' status. Our study revealed that the total time from presentation to surgery ranged 7.3 hours in average and showed a trend of increased complications with increased intervals. This finding is consistent with Mozer et al. (2017) that highlighted the effect of the delayed time to surgery which significantly raised the susceptibility of sepsis, post-surgical complications, and mortality. Other scholars like Broder et al. (2022) also observed that any time beyond 6 hours worsened outcomes with a 25% complication rate within 6–12 hours.

Thus, our study found several causes of the operational delay of patients with acute abdomen. These included time to order diagnostic tests, time to receive the surgical decision, congestion in the emergency department, and wrong diagnosis. For instance, the congestion in the emergency department was discovered to cause delays in diagnosing and referring patients to surgery, and this is well supported by Kim & Lee (2022) that indicated that crowding of ER leads to longer waits for diagnosis as well as treatment. Surgery time also varies due to a long waiting period in diagnostic imaging where patients wait for CT scans, specialized radiological assessments, etc. These results are in line with (Bouzat et al., 2020) where they observed that factors involving imaging and referral delay were the main causes of the poor outcomes in patient with acute abdominal conditions.

This study determined various areas that caused high surgical delays and these include imaging duration, time to surgical assessment, and full Emergency Department. De Burlet (2019) observed similar findings and supported the notion that ED congestion and slow availability of diagnostic test results exclusively affected the duration to surgery. Del Gaizo et al (2019) found diagnostic errors to be a critical factor, and our study also found diagnostic errors due to improper clinical decisions leading to delayed referrals for surgery.

Regarding sensitivity and specificity, physical examination in our study yielded comparatively low sensitivity of 70% and specificity of 60% in contrast to the diagnostic imaging styles. These findings are in line with (Kumar, et al., 2021) where physical examination as an essential component of diagnosis fared poorly, in comparison to imaging like e-FAST or CT. Combined with diagnostic imaging, though, serial physical exams can still contribute to reassessment of the patient's condition.

A study done by Peden et al., (2021) recommended the optimization of the hurrying technique of surgical referral since it was associated with favorable results of patients with acute abdominal emergencies. Thus, our findings that failure to adhere to ideal waiting time and the absence of guidelines for early referral and diagnosis account for a significant proportion of cases with delay has implications for decreasing morbidity and mortality. The present study, following the guidelines outlined in Strategies for Improving Early Diagnosis and Management, advocates for

velocity of imaging protocols, decrease of congestion in the emergency department, and more precise clinical assessment from first impressions. The similar suggestions are proposed by de Burlet, K. J. (2019) for enhancing the effective results of surgical interventions in cases with acute abdomen. The assessment indicated that early identification, timely surgical intervention, and appropriate application of imaging are critical for favorable outcome in these high-risk subgroups.

Conclusion

Recognizing and treating patients with the acute abdomen during the initial emergency assessment is crucial in minimizing patients' mortality and morbidity. The acute abdomen is a large range of conditions that, if not promptly diagnosed and treated, can lead to sepsis, peritonitis, or organ failure. This approach stresses the need for the use of diagnostic tools such as e-FAST and CT imaging since these improve the first time assessment substantially. On the surgical side, appropriate surgery at proper time intervals was seen to yield high patient outcomes. These causative factors include long stay in the emergency departments, and misplaced diagnosis need to be worked on by improving the flow of operations as well as clinical skills. In conclusion, early identification of cases, accurate decision-making, and timely intervention are the keys to the successful management of acute abdomen patients and better outcomes for the patient population within emergency practice.

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