



Original Research Article

Clinical Outcomes of Exploratory Laparotomy in Children with Acute Abdomen: A Prospective Observational Study

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Abstract

Background: Acute abdomen is a common paediatric surgical emergency requiring prompt diagnosis and timely intervention. Exploratory laparotomy remains the definitive treatment for many life-threatening abdominal conditions in children.

Methods: This prospective observational study was conducted over 18 months (July 2024–December 2025) at the Department of Surgery, Sri Guru Ram Das Institute of Medical Sciences and Research. Fifty children aged 0–12 years presenting with acute abdomen and undergoing exploratory laparotomy were enrolled. Demographic characteristics, clinical presentation, laboratory and radiological findings, operative details, postoperative recovery, complications, and duration of hospital stay were recorded and analyzed.

Results: Infants aged less than one year constituted the largest age group (32.0%), with a mean age of 5.14 ± 4.16 years. Females accounted for 56.0% of the study population. Most children (78.0%) had normal nutritional status. Multiple air-fluid levels were the commonest radiological finding (34.0%). The mean duration of hospital stay was 9.64 ± 5.93 days. Most patients had satisfactory postoperative recovery; however, wound infection, wound dehiscence, prolonged ileus, and stoma formation were observed in a subset of children, particularly those presenting with perforation peritonitis, bowel gangrene, severe sepsis, delayed presentation, and poor nutritional status.

Conclusion: Exploratory laparotomy is an effective lifesaving procedure for children with acute abdomen. Early diagnosis, timely surgical intervention, adequate resuscitation, and meticulous perioperative care are essential to minimize postoperative complications and improve surgical outcomes.

Keywords: Acute abdomen; Exploratory laparotomy; Paediatric surgery; Intestinal obstruction; Perforation peritonitis; Postoperative complications; Surgical outcomes.

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Introduction

Acute abdomen is one of the most common paediatric surgical emergencies and a major cause of emergency hospital admissions among children. It is characterized by the sudden onset of severe abdominal pain, often accompanied by vomiting, fever, abdominal distension, constipation, dehydration, or signs of peritonitis, requiring prompt evaluation and timely intervention to prevent serious complications.[1] Acute abdominal pain accounts for approximately 8% of visits to paediatric

emergency departments. While most cases are attributable to self-limiting medical conditions such as gastroenteritis or constipation, a significant proportion result from surgical emergencies that require urgent operative management.[1,2]

Diagnosing acute abdomen in children remains challenging because clinical presentation is frequently nonspecific. Younger children often have difficulty localizing pain or describing symptoms,

and disease progression may be rapid compared with adults, increasing the risk of delayed diagnosis and adverse outcomes.[3] Moreover, the underlying causes of acute abdomen vary with age. In neonates and infants, common surgical causes include intussusception, malrotation with volvulus, necrotizing enterocolitis, incarcerated hernia, and congenital gastrointestinal anomalies. In contrast, older children more commonly present with acute appendicitis, intestinal obstruction, perforation peritonitis, Meckel's diverticulum, abdominal tuberculosis, and abdominal trauma.[4,5] Failure to recognize and treat these conditions promptly may result in bowel ischemia, perforation, septic shock, multiorgan dysfunction, and death.[6]

Among the various surgical causes, acute appendicitis is the most frequent indication for emergency abdominal surgery in the paediatric population.[7] Complicated appendicitis, particularly when associated with perforation or generalized peritonitis, is linked to increased postoperative morbidity, prolonged hospitalization, and higher rates of infectious complications.[8] Similarly, intestinal obstruction caused by intussusception, congenital bands, postoperative adhesions, volvulus, or Meckel's diverticulum often necessitates emergency laparotomy when bowel compromise is suspected or conservative treatment is unsuccessful.[9] In low- and middle-income countries, delayed presentation remains common because of limited healthcare access and referral delays, resulting in advanced disease with bowel gangrene, perforation, diffuse peritonitis, or severe sepsis at the time of surgery.[10]

Exploratory laparotomy continues to play a pivotal role in the management of paediatric acute abdomen. It is indicated in children presenting with generalized peritonitis, gastrointestinal perforation, strangulated intestinal obstruction, worsening sepsis, failure of non-operative management, or when the diagnosis remains uncertain despite appropriate clinical and radiological evaluation.[11] In addition to establishing the definitive diagnosis, exploratory laparotomy provides therapeutic management through procedures such as appendectomy, adhesiolysis, bowel resection with primary anastomosis, repair of perforation, stoma formation, and reduction of intussusception, depending on the intraoperative findings.[12]

The outcomes following exploratory laparotomy are influenced by multiple patient- and disease-related factors, including age, nutritional status, duration of symptoms before presentation, severity of intra-abdominal contamination, bowel viability, presence of sepsis, operative findings, and the quality of perioperative and postoperative care.[13] Children presenting late in the course of illness are more likely to develop postoperative complications such as surgical site infection, wound dehiscence, intra-

abdominal abscess, postoperative ileus, burst abdomen, respiratory complications, electrolyte disturbances, prolonged hospitalization, and mortality.[14] Among these, surgical site infection remains the most frequent complication because emergency laparotomies are often performed in contaminated or dirty operative fields.[15]

The burden of postoperative morbidity and mortality following emergency abdominal surgery is considerably greater in low- and middle-income countries than in high-income settings. Delayed diagnosis, inadequate referral systems, limited availability of paediatric surgical expertise, constrained intensive care resources, and suboptimal perioperative support contribute substantially to poorer surgical outcomes.[16] Consequently, evaluating the clinical profile, operative indications, intraoperative findings, postoperative complications, duration of hospital stay, and mortality among children undergoing exploratory laparotomy is essential for identifying modifiable risk factors and improving the quality of paediatric surgical care.[17]

In view of these considerations, the present study was undertaken to evaluate the outcomes of exploratory laparotomy in children presenting with acute abdomen, with particular emphasis on clinical presentation, operative indications, intraoperative findings, postoperative complications, duration of hospital stay, and overall treatment outcomes.

Methodology:

This prospective observational study was conducted in the Department of Surgery in collaboration with the Department of Paediatrics at Sri Guru Ram Das Institute of Medical Sciences and Research over a period of 18 months, from July 2024 to December 2025.

The study included children aged 0–12 years admitted through the emergency services or inpatient department with acute abdomen requiring emergency exploratory laparotomy. Children older than 12 years, those managed conservatively without surgical intervention, neonates with birth weight <700 g, and patients undergoing exploratory laparotomy for traumatic abdominal injuries were excluded.

Prior approval was obtained from the Institutional Research and Ethics Committee of Sri Guru Ram Das University of Health Sciences. Written informed consent was obtained from the legally authorized representative of each participant, and assent was obtained from older children whenever applicable.

At admission, all patients underwent detailed clinical evaluation, including history regarding the onset and duration of abdominal pain, vomiting, abdominal distension, constipation, fever, previous

medical or surgical illness, and associated comorbidities. A comprehensive general physical examination and detailed abdominal examination were performed.

Baseline laboratory investigations included complete blood count, serum electrolytes, renal function tests, serum amylase, serum lipase, and other relevant investigations as clinically indicated. Radiological assessment comprised erect abdominal X-ray and ultrasonography of the abdomen and pelvis, with additional imaging performed when necessary. The diagnosis of acute abdomen was established based on clinical, laboratory, and radiological findings. After adequate preoperative resuscitation, all patients underwent emergency exploratory laparotomy under general anaesthesia.

Clinical data were recorded using a structured predesigned proforma. Variables collected included demographic characteristics, nutritional status, clinical presentation, duration of symptoms, laboratory and radiological findings, operative diagnosis, intraoperative findings, surgical procedure performed, postoperative recovery, and postoperative complications.

The primary outcome measures were postoperative recovery and surgical outcomes. Recovery parameters included time to return of bowel sounds, passage of flatus, passage of first stool, initiation of oral or Ryle's tube feeding, drain removal, duration of hospital stay, and discharge status. Postoperative complications such as surgical site infection, wound dehiscence, prolonged Ryle's tube drainage, stoma formation, re-exploration, and mortality were documented. All patients were followed for one month after hospital discharge.

The surgical procedure was individualized according to the intraoperative diagnosis. Children with intestinal perforation underwent primary repair, wedge resection with closure, bowel resection with anastomosis, or stoma creation depending on bowel viability and the extent of peritoneal contamination. Intussusception was managed by hydrostatic reduction, manual reduction, bowel resection with anastomosis, hemicolectomy, or stoma formation as indicated. Meckel's diverticulum was treated by diverticulectomy or segmental bowel resection with anastomosis. Patients with acute appendicitis underwent appendectomy, while those with abdominal tuberculosis, ascariasis, or other surgical pathologies received appropriate operative management based on intraoperative findings.

Statistical analysis was performed using appropriate statistical software. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequencies and percentages. Appropriate inferential statistical tests were applied according to the type and

distribution of data. A p-value <0.05 was considered statistically significant.

Results:

A total of 50 children who underwent exploratory laparotomy for acute abdomen were included in the study. The largest proportion of patients were infants aged less than 1 year (32.0%), followed by children aged 5–8 years (28.0%), 9–12 years (26.0%), and 1–4 years (14.0%). The mean age of the study population was 5.14 ± 4.16 years. Females constituted 56.0% ($n=28$) of the study population, while males accounted for 44.0% ($n=22$). Most children (78.0%) had normal nutritional status at admission, whereas 22.0% were undernourished (Table 1). The baseline clinical and biochemical characteristics are summarized in Table 2. The mean body weight was 17.96 ± 10.01 kg. The mean hemoglobin level was 10.99 ± 1.58 g/dL, indicating mild anemia in a proportion of patients, while the mean total leukocyte count was $13,608.74 \pm 4,524.57/\text{mm}^3$, reflecting the acute inflammatory response. Mean serum electrolyte levels and renal function parameters were within acceptable limits. The mean duration of hospital stay was 9.64 ± 5.93 days. Radiographic evaluation of the abdomen demonstrated multiple air-fluid levels as the most frequent finding, observed in 17 patients (34.0%). Gasless abdomen with free intraperitoneal air was present in 14.0% of cases, while a soft tissue mass associated with a few air-fluid levels was noted in 12.0%. Paucity of gas in the right abdomen and multiple air-fluid levels with free air were each observed in 10.0% of children. Dilated small bowel loops with central air-fluid levels were seen in 8.0% of patients. Less common findings included free air under the diaphragm (4.0%), non-specific radiographic findings (4.0%), isolated few air-fluid levels (2.0%), and dilatation of the stomach or duodenum with distal gas paucity (2.0%) (Table 3). The postoperative course was satisfactory in the majority of children, with gradual recovery characterized by return of bowel sounds, passage of flatus, initiation of enteral feeding, and satisfactory wound healing. The average duration of hospitalization was 9.64 ± 5.93 days. Nevertheless, postoperative complications including wound infection, wound dehiscence, prolonged postoperative ileus, and stoma formation were observed in a subset of patients. These complications occurred more frequently among children presenting with delayed illness, perforation peritonitis, bowel gangrene, or severe sepsis.

Overall, the study demonstrated favorable surgical outcomes following exploratory laparotomy in most children with acute abdomen. Early diagnosis, prompt surgical intervention, and appropriate perioperative management were associated with successful recovery, whereas delayed presentation,

extensive intra-abdominal contamination, severe sepsis, and undernutrition contributed to increased postoperative morbidity and prolonged hospital stay.

Table 1. Demographic Characteristics of the Study Population (N = 50)

Variable	Number (n)	Percentage (%)
Age Group		
<1 year	16	32.0
1–4 years	7	14.0
5–8 years	14	28.0
9–12 years	13	26.0
Sex		
Male	22	44.0
Female	28	56.0
Nutritional Status		
Normal	39	78.0
Undernourished	11	22.0

Table 2. Baseline Clinical and Biochemical Parameters of the Study Population

Parameter	Mean $\pm$ SD
Age (years)	5.14 $\pm$ 4.16
Weight (kg)	17.96 $\pm$ 10.01
Hemoglobin (g/dL)	10.99 $\pm$ 1.58
Total Leukocyte Count (/mm ³)	13,608.74 $\pm$ 4,524.57
Serum Sodium (mmol/L)	133.42 $\pm$ 4.14
Serum Potassium (mmol/L)	4.06 $\pm$ 0.51
Serum Chloride (mmol/L)	100.32 $\pm$ 3.91
Serum Calcium (mg/dL)	9.35 $\pm$ 0.63

Urea (mg/dL)	25.28 ± 9.92
Creatinine (mg/dL)	0.52 ± 0.17
Length of Hospital Stay (days)	9.64 ± 5.93

Table 3. X-ray Erect Abdomen Findings among the Study Population (N = 50)

X-ray Finding	Number (n)	Percentage (%)
Multiple air-fluid levels	17	34.0
Gasless abdomen with free air	7	14.0
Soft tissue mass with few air-fluid levels	6	12.0
Paucity of gas in right abdomen	5	10.0
Multiple air-fluid levels with free air	5	10.0
Dilated small bowel with central air-fluid levels	4	8.0
Free air under diaphragm	2	4.0
Non-specific findings	2	4.0
Few air-fluid levels	1	2.0
Dilated stomach/duodenum with distal gas paucity	1	2.0

Baseline Clinical and Biochemical Parameters of the Study Population

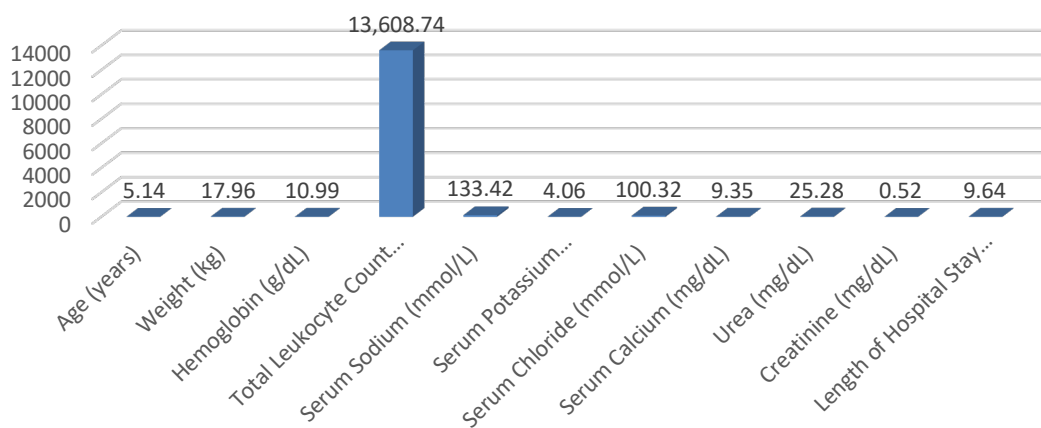
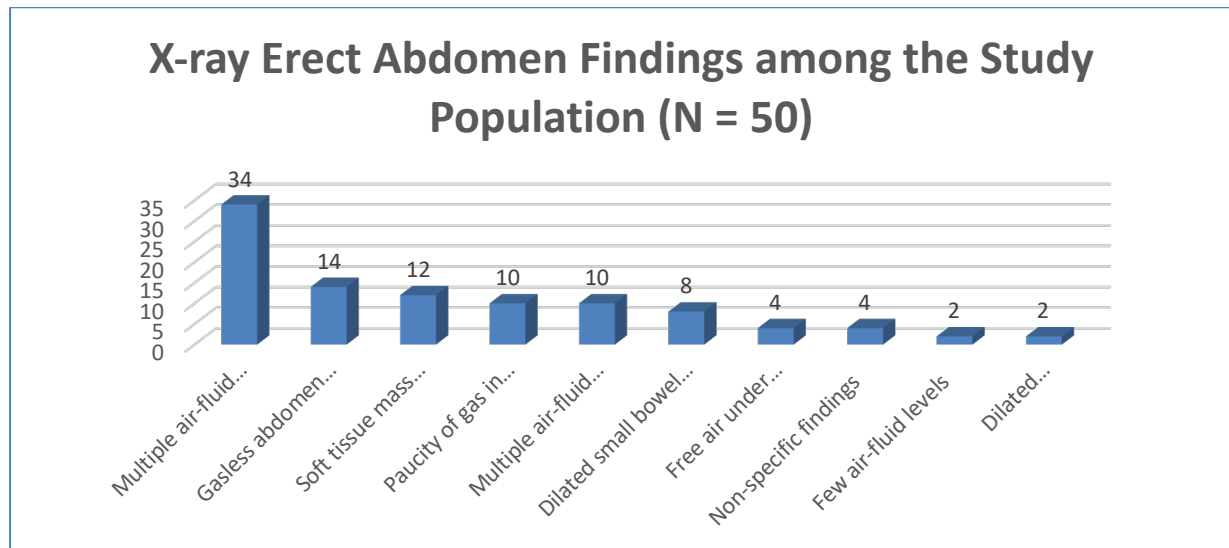


Figure 1 Baseline Clinical and Biochemical Parameters of the Study Population**Figure 2 X-ray Erect Abdomen Findings among the Study Population (N = 50)****Discussion:**

In the present study, the highest proportion of children undergoing exploratory laparotomy belonged to the age group of less than 1 year (32.0%), followed by those aged 5–8 years (28.0%) and 9–12 years (26.0%). The mean age of the study population was 5.14 ± 4.16 years, with a slight female predominance (56.0%). These findings are consistent with those reported by Mboutol-Mandavo C et al. (2020), who observed that paediatric abdominal surgical emergencies occurred predominantly in younger children, particularly those under 5 years of age.[18] Similarly, Abantanga FA et al. (2009) reported that congenital anomalies, intestinal obstruction, and other acute abdominal conditions were more frequently encountered in infants and young children, resulting in a greater need for emergency surgical intervention.[19] The predominance of younger children in the present study is likely attributable to the higher incidence of congenital gastrointestinal disorders, intussusception, bowel obstruction, and perforation peritonitis in this age group.

Assessment of nutritional status showed that 22.0% of the children were undernourished, whereas 78.0% had normal nutritional status. Undernutrition is a well-recognized risk factor for poor wound healing, postoperative infection, prolonged recovery, and increased morbidity following major abdominal surgery. Comparable findings were reported by Firomsa T et al. (2018), who demonstrated

significantly higher postoperative complication rates and longer hospital stays among malnourished paediatric surgical patients.[20] Likewise, Nelson O et al. (2024) found that children with poor nutritional reserves, particularly those presenting with sepsis, required prolonged postoperative support and intensive care management.[21] These observations emphasize the importance of early nutritional assessment and optimization as part of perioperative care in children undergoing emergency laparotomy.

The mean hemoglobin concentration in the present study was 10.99 ± 1.58 g/dL, while the mean total leukocyte count was $13,608.74 \pm 4,524.57/\text{mm}^3$. Mild anemia and leukocytosis were common laboratory findings, reflecting the inflammatory and infective nature of acute abdominal pathology. Similar observations were reported by Abed BA et al. (2022), who found that children presenting with acute surgical abdomen frequently exhibited leukocytosis and varying degrees of anemia.[22] Elevated leukocyte counts have consistently been associated with bowel ischemia, perforation, generalized peritonitis, and systemic sepsis, thereby serving as an important marker of disease severity in paediatric acute abdomen.

Radiological evaluation revealed that multiple air-fluid levels were the most frequent X-ray finding (34.0%), followed by gasless abdomen with free intraperitoneal air (14.0%) and soft tissue mass with a few air-fluid levels (12.0%). These findings were suggestive of intestinal obstruction, bowel

perforation, and intussusception. Similar radiographic patterns have been described by Thomas S et al. (2017), who reported that multiple air-fluid levels, dilated bowel loops, and pneumoperitoneum were the commonest imaging findings in children requiring emergency exploratory laparotomy.[23] Advanced imaging modalities, including contrast-enhanced computed tomography, were selectively used in complicated or diagnostically challenging cases, which is comparable to the experience reported by Nelson O et al. (2024), where advanced imaging improved diagnostic accuracy in children with complex intra-abdominal pathology.[21]

The mean duration of hospital stay in the present study was 9.64 ± 5.93 days. Longer hospitalization was observed among children presenting with perforation peritonitis, bowel gangrene, severe sepsis, postoperative wound infection, and delayed presentation. Comparable findings were reported by Mboutol-Mandavo C et al. (2020), who demonstrated that generalized peritonitis and bowel perforation significantly prolonged postoperative recovery and hospital stay.[18] Similarly, Abantanga FA et al. (2009) identified delayed referral and advanced intra-abdominal disease as major contributors to increased postoperative morbidity and prolonged hospitalization.[19] These findings underscore the importance of early diagnosis, prompt referral, and timely surgical intervention in improving patient outcomes.

Postoperative wound infection was among the most frequently encountered complications in the present study and occurred predominantly in children with perforation peritonitis, bowel gangrene, severe contamination, and delayed presentation. Similar observations were reported by Prajapati AJ et al. (2024), who identified perforation peritonitis as a major predictor of postoperative surgical site infection and adverse surgical outcomes.[24] Likewise, Mboutol-Mandavo C et al. (2020) and Abantanga FA et al. (2009) reported that generalized peritoneal contamination substantially increased the risk of postoperative wound complications and delayed recovery.[18,19]

Wound dehiscence occurred in a small number of patients and was observed primarily in those who had developed postoperative wound infection. Thomas S et al. (2017) similarly reported that severe intra-abdominal sepsis, poor wound healing, and surgical site infection were important predisposing factors for wound dehiscence and burst abdomen in paediatric patients.[23] Prajapati AJ et al. (2024) also demonstrated a strong association between postoperative wound infection and subsequent wound failure following exploratory laparotomy.[24]

Stoma formation was performed selectively in children with bowel gangrene, perforation, or extensive intra-abdominal contamination. In the present study, diversion stoma facilitated safe management of severely diseased bowel without increasing the incidence of wound dehiscence. Similar findings were reported by Ghritlaharey RK et al. (2011), who concluded that temporary stoma formation protects bowel repair, minimizes anastomotic complications, and contributes to improved postoperative recovery in selected paediatric patients with severe intestinal pathology.[9]

Overall, the findings of the present study indicate that exploratory laparotomy provides favorable outcomes in the majority of children presenting with acute abdomen when timely diagnosis and appropriate surgical intervention are achieved. Nevertheless, delayed presentation, bowel perforation, generalized peritonitis, severe sepsis, undernutrition, and postoperative wound infection remain significant determinants of postoperative morbidity, prolonged hospitalization, and delayed recovery. Early recognition, prompt referral, meticulous perioperative management, and optimization of nutritional status are essential for improving surgical outcomes in this vulnerable patient population.

Conclusion

The present study demonstrated that exploratory laparotomy is an essential and effective surgical intervention for children presenting with acute abdomen, particularly in conditions such as intestinal obstruction, perforation peritonitis, bowel gangrene, and other life-threatening abdominal emergencies. Most children experienced favorable postoperative outcomes when diagnosis was established early and surgical management was undertaken promptly.

Delayed presentation, generalized peritonitis, severe sepsis, poor nutritional status, and extensive intra-abdominal contamination were identified as important determinants of postoperative complications, prolonged hospital stay, and delayed recovery. These findings highlight the importance of early recognition, timely referral to specialized surgical centers, adequate preoperative resuscitation, meticulous surgical technique, and comprehensive postoperative care.

Strengthening emergency paediatric surgical services, promoting early diagnosis, and optimizing perioperative management can substantially reduce postoperative morbidity and improve overall outcomes in children undergoing exploratory laparotomy for acute abdomen.

Limitations of the Study

The present study was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings to the broader paediatric population. The follow-up period was limited to one month after surgery; therefore, long-term postoperative complications, functional outcomes, and quality-of-life measures could not be evaluated. Furthermore, the inclusion of children with diverse underlying surgical pathologies and varying operative procedures may have introduced heterogeneity, potentially influencing the observed postoperative outcomes and limiting disease-specific comparisons.

Ethical approval

Ethical approval for this study was obtained from the Institutional Ethics Committee prior to the commencement of the study. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and applicable institutional guidelines.

Informed Consent

Written informed consent was obtained from all participants prior to their enrolment in the study.

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Conflict of Interest Declaration

The authors declare no conflict of interest.

Data Availability Statement

All data generated or analysed during this study are available from the corresponding author upon reasonable request.

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