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Laparoscopic Management Of Pediatric Abdominal Surgical Emergencies At A Tertiary Care Centre

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ABSTRACT

Background: Intestinal malrotation and its associated complications represent important causes of pediatric abdominal emergencies, particularly in the neonatal and early infancy period. Delay in diagnosis may result in volvulus, bowel ischemia, perforation, sepsis, and mortality.

Objective: To analyze the clinical presentation, operative findings, management, and outcomes of pediatric patients presenting with malrotation and related intestinal pathologies in a tertiary care center.

Methods: This case series includes ten pediatric patients ranging from 4 days to 16 years of age. Clinical data were reviewed with emphasis on age at presentation, presenting symptoms, intraoperative findings, surgical procedures performed, and postoperative outcomes. The primary surgical intervention for malrotation was Ladd's procedure, with additional corrective procedures performed when indicated.

Results: Neonates predominantly presented with bilious vomiting and feed intolerance, whereas older children presented with abdominal pain, distension, and features of obstruction. Midgut volvulus, duodenal atresia, congenital bands, and perforative peritonitis were observed intraoperatively. Ladd's procedure was performed in all malrotation-associated cases. Eight patients recovered completely, one was discharged in stable condition at request, and one neonatal patient with gangrenous bowel and septic shock expired. Mortality was directly associated with delayed presentation and irreversible bowel ischemia.

Conclusion: Early recognition and timely surgical intervention are critical determinants of outcome in pediatric malrotation. When treated before the development of bowel necrosis, prognosis is excellent..

KEYWORDS: Intestinal malrotation; Midgut volvulus; Ladd's procedure; Duodenal atresia; Bilious vomiting; Pediatric intestinal obstruction; Neonatal emergency; Bowel ischemia; Perforative peritonitis; Pediatric surgerys**.**

INTRODUCTION

Congenital and acquired abdominal emergencies constitute a major proportion of surgical admissions in the neonatal and pediatric age group (1). Among these, intestinal malrotation and its complications particularly midgut volvulus, intestinal obstruction, and associated congenital anomalies such as duodenal atresia represent time-critical conditions requiring prompt diagnosis and surgical intervention (2). Malrotation results from abnormal rotation and fixation of the midgut during embryological development, leading to a narrow mesenteric base and predisposition to volvulus. The consequent vascular compromise can rapidly progress to bowel ischemia, necrosis, perforation, sepsis, and death if not treated urgently. Clinical presentation varies with age, ranging from bilious vomiting and feed intolerance in neonates to recurrent abdominal pain, distension, and obstructive symptoms in older infants and children (3).

Duodenal atresia and obstructing congenital bands may coexist with malrotation, further compounding the severity of obstruction (4). In neonates, bilious vomiting is considered a surgical emergency until proven otherwise, often warranting immediate radiological evaluation and operative exploration (5). In complicated cases, delayed presentation may result in

perforative peritonitis or septic shock, significantly increasing morbidity and mortality. Early recognition and timely surgical correction are therefore critical determinants of outcome (6).

The Ladd's procedure remains the cornerstone of surgical management for malrotation. It involves detorsion of volvulus (if present), division of Ladd's bands, widening of the mesenteric base, and placement of the bowel in a nonrotated position, often combined with appendectomy (7). In cases associated with duodenal atresia, web, or perforation, additional corrective procedures such as duodenal repair or perforation closure are required (8). Over recent decades, minimally invasive approaches have gained increasing acceptance in pediatric surgery. Laparoscopic techniques allow both diagnostic confirmation and definitive management, offering advantages such as reduced postoperative pain, earlier initiation of feeds, shorter hospital stay, and improved cosmetic outcomes (9).

Despite advances in neonatal intensive care and surgical techniques, outcomes largely depend on the timing of intervention and the presence of bowel viability at exploration. Neonates presenting with advanced ischemia or systemic sepsis continue to carry a guarded prognosis (10). Given the spectrum of presentations from uncomplicated obstruction to gangrenous bowel with septic shock a case series documenting varied clinical scenarios provides valuable insight into disease patterns, operative strategies, and outcomes in a tertiary care setting (3). Such documentation contributes to improved clinical awareness and reinforces the importance of early diagnosis and timely surgical management in pediatric abdominal emergencies (11).

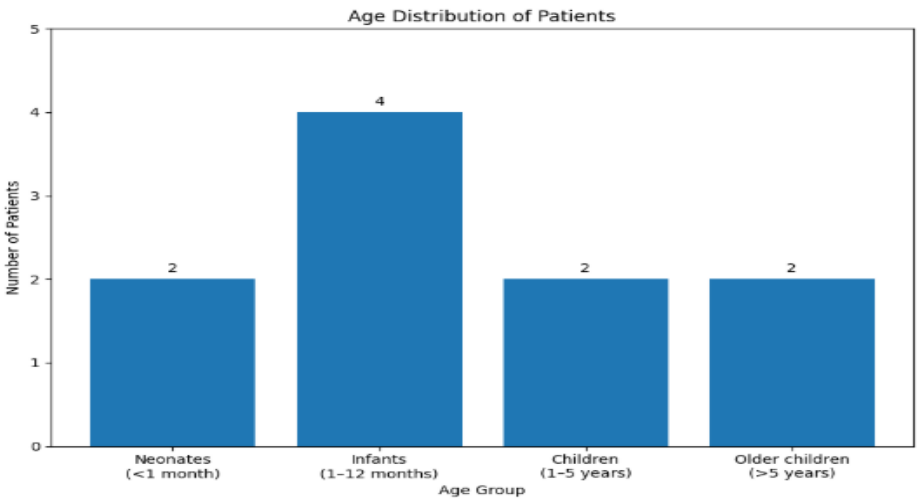
RESULTS

A total of 10 pediatric patients presenting with abdominal surgical emergencies were included in the study. The age ranged from 4 days to 16 years, with most cases occurring in neonates and infants. Vomiting and abdominal distension were the most common presenting symptoms. Intestinal malrotation was the predominant operative diagnosis and Ladd's procedure was the principal surgical intervention performed.

Table 1: Age Distribution of Patients

Age Group	Number of Patients	Percentage
Neonates (<1 month)	2	20%
Infants (1–12 months)	4	40%
Children (1–5 years)	2	20%
Older children (>5 years)	2	20%
Total	10	100%

Graph 1: Age Distribution of Patients

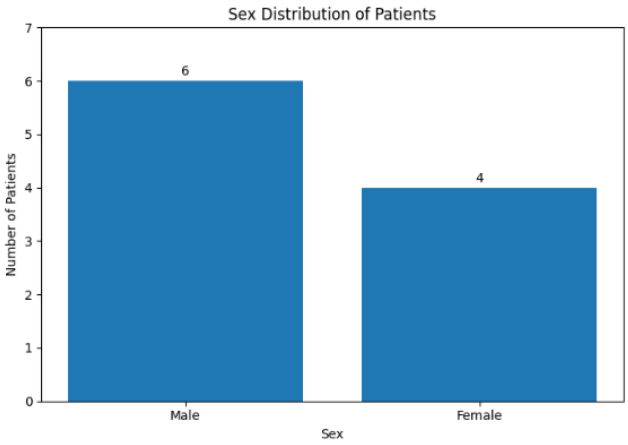


The majority of patients presented during infancy (40%), followed by neonates and older children. This pattern reflects the early manifestation of congenital intestinal anomalies such as malrotation and duodenal obstruction. In the present study, a total of 10 pediatric patients with abdominal surgical emergencies were analyzed according to age distribution. Neonates (<1 month) accounted for 2 patients (20%). Infants aged 1–12 months constituted the largest group with 4 patients (40%). Children aged 1–5 years comprised 2 patients (20%), while older children (>5 years) also accounted for 2 patients (20%). Overall, infants represented the highest proportion of cases, while neonates, children aged 1–5 years, and older children each contributed equally to the study population.

Table 2: Sex Distribution of Patients

Sex	Number of Patients	Percentage
Male	6	60%
Female	4	40%
Total	10	100%

Graph 2: Sex Distribution of Patients

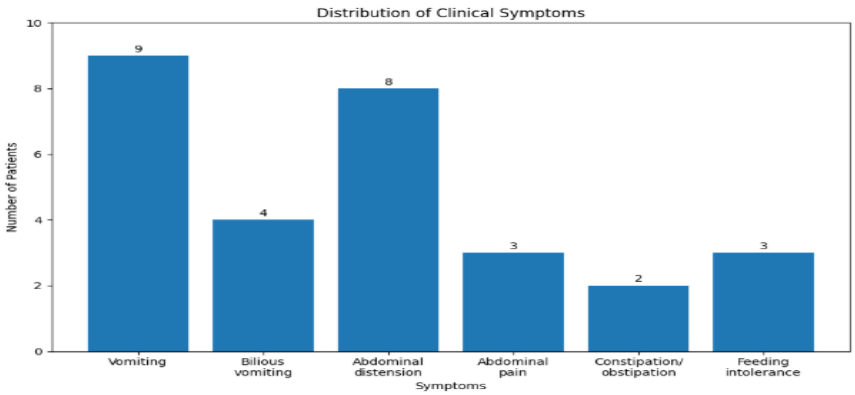


A slight male predominance (60%) was observed in the study population, which is consistent with previously reported epidemiological patterns in congenital gastrointestinal disorders. In the present study, a total of 10 pediatric patients were analyzed according to sex distribution. Male patients constituted 6 cases (60%), while female patients accounted for 4 cases (40%). Thus, male patients formed the majority of the study population compared to female patients. The bar graph above illustrates the sex-wise distribution of patients, with vertical axis labels and data labels indicating the number of patients in each category.

Table 3: Distribution of Clinical Symptoms

Symptom	Number of Patients	Percentage
Vomiting	9	90%
Bilious vomiting	4	40%
Abdominal distension	8	80%
Abdominal pain	3	30%
Constipation/obstipation	2	20%
Feeding intolerance	3	30%

Graph 3: Distribution of Clinical Symptoms

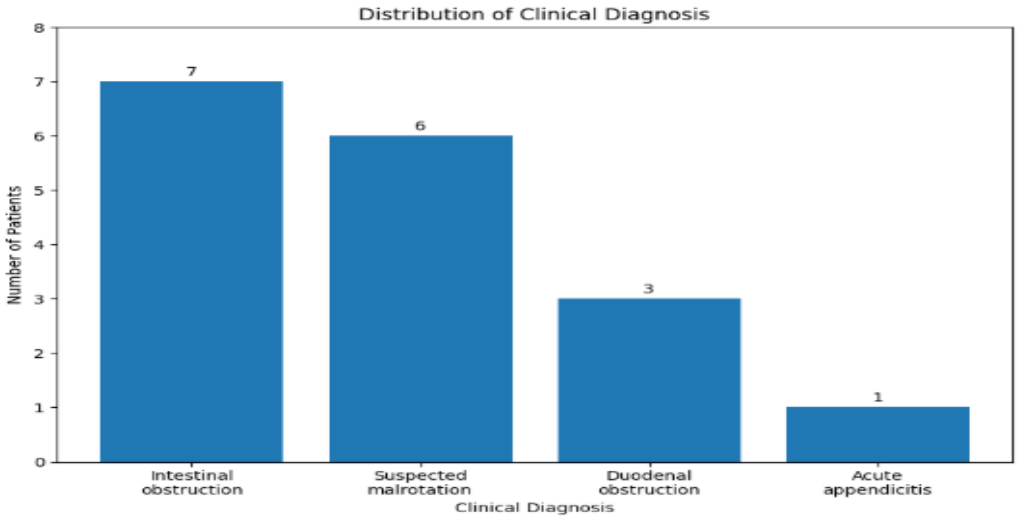


Vomiting was the most frequent symptom (90%), followed by abdominal distension (80%). Bilious vomiting, a classical sign of proximal intestinal obstruction, was primarily observed in neonates and infants. In the present study, the most common presenting symptom was vomiting, observed in 9 patients (90%). Abdominal distension was the next most frequent symptom, present in 8 patients (80%). Bilious vomiting was noted in 4 patients (40%). Abdominal pain and feeding intolerance were each reported in 3 patients (30%). Constipation/obstipation was the least common symptom, observed in 2 patients (20%).

Table 4: Distribution of Clinical Diagnosis

Clinical Diagnosis	Number of Patients	Percentage
Intestinal obstruction	7	70%
Suspected malrotation	6	60%
Duodenal obstruction	3	30%
Acute appendicitis	1	10%

Graph 4: Distribution of Clinical Diagnosis

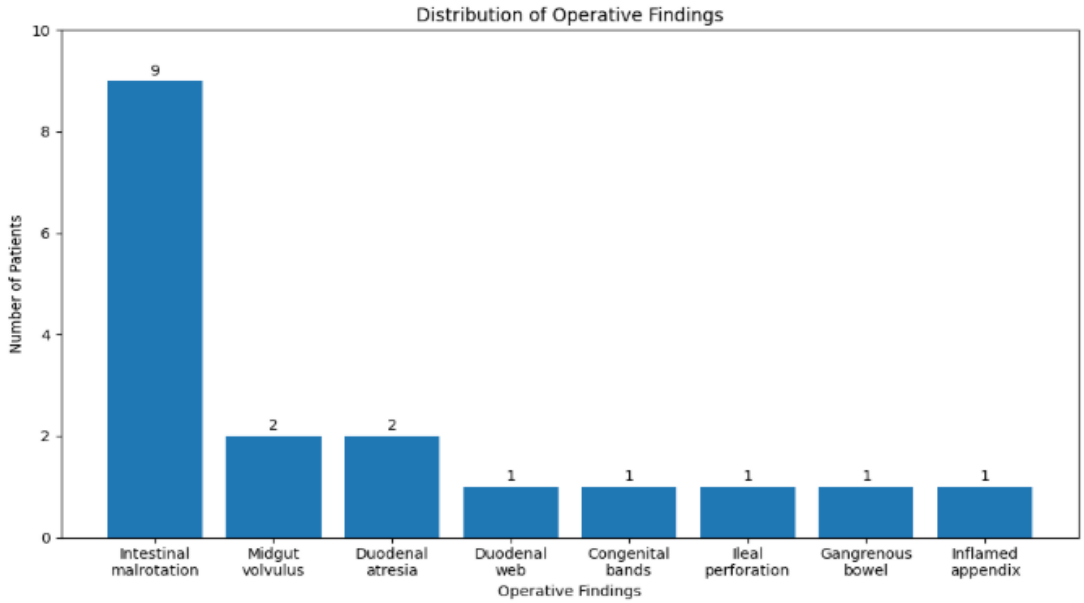


Most patients presented with features of intestinal obstruction (70%), suggesting that obstructive pathology remains the dominant clinical scenario in pediatric abdominal surgical emergencies. In the present study, intestinal obstruction was the most common clinical diagnosis, observed in 7 patients (70%). Suspected malrotation was noted in 6 patients (60%). Duodenal obstruction was present in 3 patients (30%). Acute appendicitis was the least common diagnosis, identified in 1 patient (10%).

Table 5: Distribution Of Operative Findings

Finding	Number of Patients	Percentage
Intestinal malrotation	9	90%
Midgut volvulus	2	20%
Duodenal atresia	2	20%
Duodenal web	1	10%
Congenital bands	1	10%
Ileal perforation	1	10%
Gangrenous bowel	1	10%
Inflamed appendix	1	10%

Graph 5: Distribution Of Operative Findings

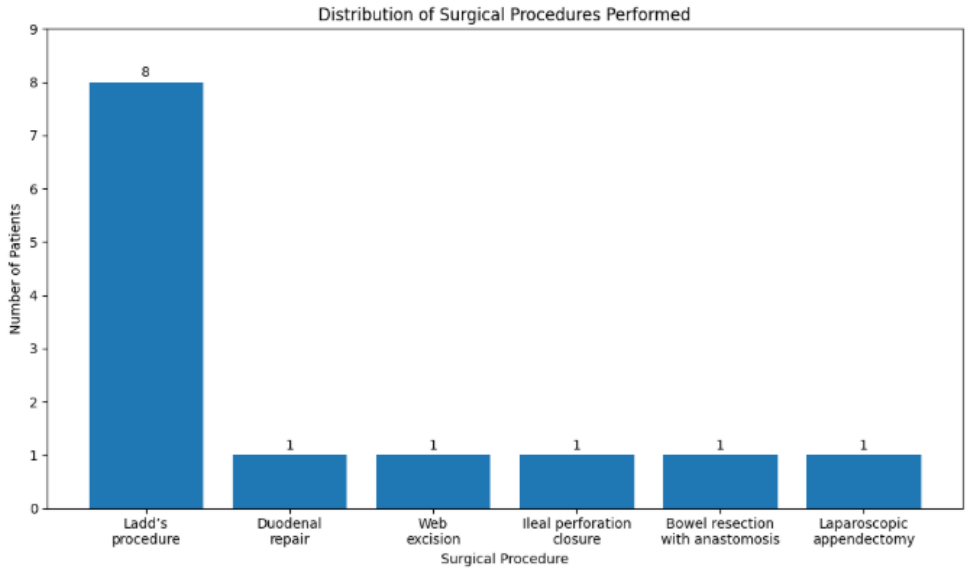


Intestinal malrotation was the dominant operative finding (90%). Midgut volvulus and bowel gangrene represented the most severe complications because they may rapidly lead to bowel ischemia and mortality. In the present study, intestinal malrotation was the most common operative finding, observed in 9 patients (90%). Midgut volvulus was identified in 2 patients (20%), and duodenal atresia was also noted in 2 patients (20%). Duodenal web, congenital bands, ileal perforation, gangrenous bowel, and inflamed appendix were each observed in 1 patient (10%).

Table 6: Distribution of Surgical Procedures Performed

Surgical Procedure	Number of Patients	Percentage
Ladd's procedure	8	80%
Duodenal repair	1	10%
Web excision	1	10%
Ileal perforation closure	1	10%
Bowel resection with anastomosis	1	10%
Laparoscopic appendectomy	1	10%

Graph 6: Distribution of Surgical Procedures Performed

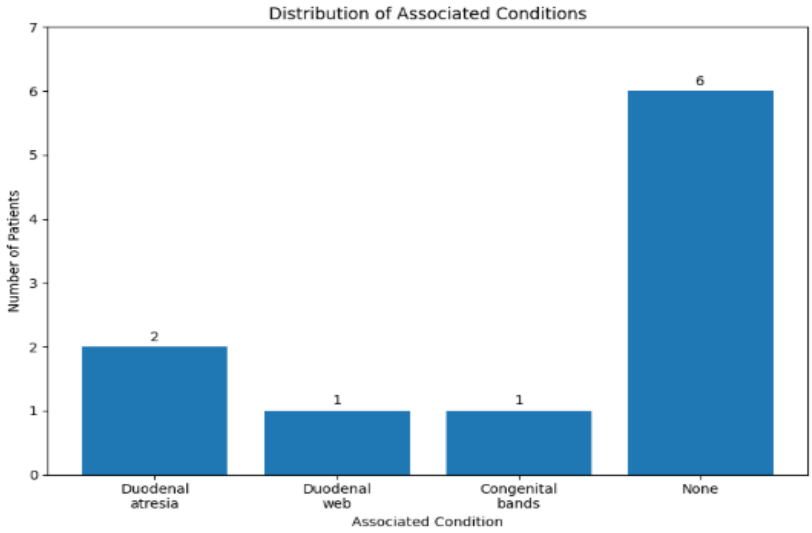


Ladd's procedure was the most common surgical procedure (80%), confirming its central role in the management of intestinal malrotation. In the present study, Ladd's procedure was the most commonly performed surgical procedure, carried out in 8 patients (80%). Duodenal repair was performed in 1 patient (10%). Web excision was also performed in 1 patient (10%). Ileal perforation closure was done in 1 patient (10%). Bowel resection with anastomosis was performed in 1 patient (10%), and laparoscopic appendectomy was carried out in 1 patient (10%).

Table 7: Distribution of Associated Conditions

Associated Condition	Number of Patients	Percentage
Duodenal atresia	2	20%
Duodenal web	1	10%
Congenital bands	1	10%
None	6	60%

Graph 7: Distribution of Associated Conditions



Associated congenital anomalies were present in 40% of cases, indicating that malrotation frequently coexists with other structural gastrointestinal abnormalities. In the present study, associated conditions were analyzed among the patients. Duodenal atresia was observed in 2 patients (20%). Duodenal web was identified in 1 patient (10%), and congenital bands

were also present in 1 patient (10%). No associated condition was noted in 6 patients (60%).

Table 8: Distribution of Postoperative Complications

Complication	Number of Patients	Percentage
Septic shock	1	10%
Respiratory distress	1	10%
No complications	8	80%

Most patients (80%) had an uneventful postoperative course. Severe complications were mainly observed in patients with advanced disease at presentation. In the present study, postoperative complications were observed in a small proportion of patients. Septic shock occurred in 1 patient (10%), and respiratory distress was also observed in 1 patient (10%). The majority of patients, 8 (80%), did not develop any postoperative complications.

Table 9: Distribution of Patient Outcomes

Outcome	Number of Patients	Percentage
Recovered and discharged	8	80%
Discharged at parental request	1	10%
Mortality	1	10%
Total	10	100%

The overall survival rate was 90%, with mortality limited to a neonate presenting with advanced septic shock and gangrenous bowel. In the present study, the majority of patients recovered and were discharged, accounting for 8 patients (80%). Discharge at parental request was noted in 1 patient (10%). Mortality was observed in 1 patient (10%). Overall, the total number of patients included in the studywas 10 (100%).

Table 10: Relationship Between Bowel Viability and Outcome

Bowel Status	Number of Patients	Survival	Mortality
Viable bowel	9	9	0
Gangrenous bowel	1	0	1

Outcome was strongly associated with bowel viability at the time of surgery. All patients with viable bowel survived, whereas the only mortality occurred in the patient with gangrenous bowel. In the present study, bowel status was analyzed in relation to patient outcome. A total of 9 patients had viable bowel, and all 9 patients survived with no mortality. One patient had gangrenous bowel, in whom survival was not observed and mortality occurred in 1 case.

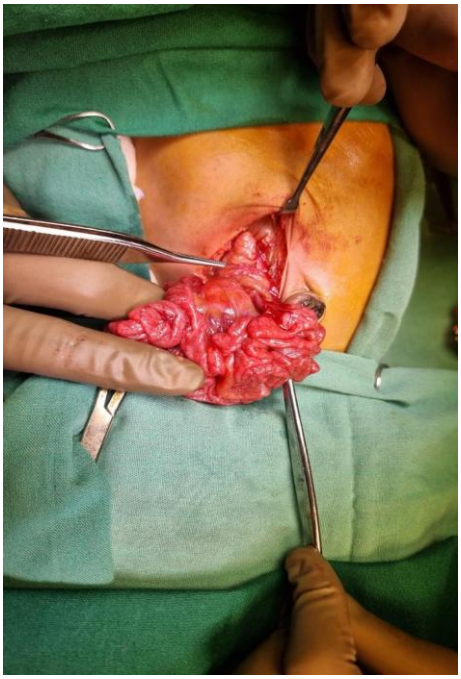


Fig 1: Intraoperative Image of Midgut Volvulus During Ladd's Procedure in a Pediatric Patient

Fig 2: Intraoperative Appearance of Twisted Small Bowel in Pediatric Midgut Volvulus

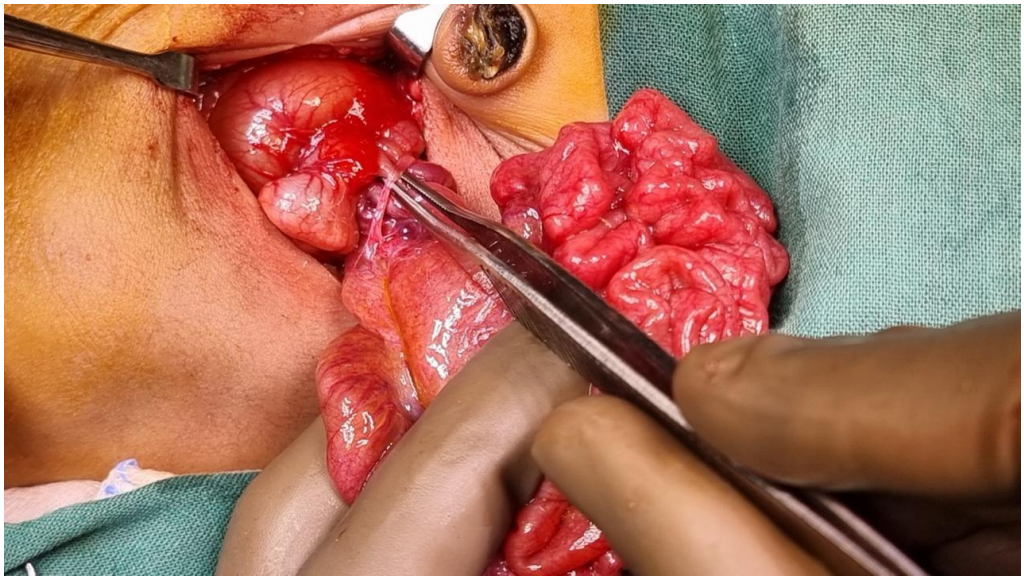


Fig 3: Intraoperative Detorsion of Midgut Volvulus During Ladd's Procedure in a Neonate

DISCUSSION

The present study evaluated the clinical presentation, operative findings, surgical management, and outcomes of pediatric patients presenting with abdominal surgical emergencies. The majority of patients in the present series were neonates and infants, indicating that congenital gastrointestinal anomalies commonly manifest early in life. Similar observations have been reported in previous literature, where congenital conditions such as intestinal malrotation, duodenal atresia, and congenital bands typically present during the neonatal or early infancy period (Tayade et al., 2022; Akre et al., 2022) (1,17). Bilious vomiting and abdominal distension were the most common presenting symptoms in this study. Bilious vomiting is widely recognized as an important warning sign of intestinal obstruction in neonates and infants and requires urgent surgical evaluation (Tullie and Stanton, 2022; Moore and Kazmierski, 2024) (5,16).

Intestinal obstruction was the most frequent clinical diagnosis in the present study, which is consistent with reports indicating that obstructive pathologies represent the most common cause of pediatric abdominal surgical emergencies (Tayade et al., 2022) (1). Among the operative findings, intestinal malrotation was the predominant pathology observed. Malrotation is a developmental anomaly resulting from incomplete rotation and fixation of the midgut during embryogenesis, and it may predispose to midgut volvulus and life-threatening bowel ischemia if not promptly treated (Alani and Rentea, 2023) (2). Similar findings have been described in other studies where malrotation accounted for a substantial proportion of neonatal intestinal obstruction cases (Akre et al., 2022) (17).

Midgut volvulus and gangrenous bowel were identified in a small number of patients in the present study but represented the most severe complications. Volvulus can rapidly compromise intestinal blood supply, leading to bowel necrosis and increased mortality if diagnosis and intervention are delayed (Alani and Rentea, 2023) (2). Early recognition of symptoms and prompt surgical intervention are therefore critical in preventing irreversible bowel damage and improving survival outcomes (Tayade et al., 2022) (1).

Ladd's procedure was the most commonly performed surgical intervention in this study, reflecting its established role as the definitive treatment for intestinal malrotation. The procedure involves division of Ladd's bands, widening of the mesenteric base, and repositioning of the bowel to prevent future volvulus (Alani and Rentea, 2023) (2). Previous studies have also emphasized the effectiveness of Ladd's procedure in relieving obstruction and preventing recurrence, with favorable postoperative outcomes in most patients (Saberi et al., 2022) (23). Advances in surgical techniques, including laparoscopic approaches, have further improved outcomes and reduced postoperative morbidity in selected cases (Nygren and Håkanson, 2025; Buia et al., 2015) (7,9).

In addition to malrotation, other congenital anomalies such as duodenal atresia, duodenal web, and congenital bands were observed in some patients. These anomalies are well-recognized causes of neonatal intestinal obstruction and often coexist with other developmental abnormalities (Patterson et al., 2022; Weledji and Monono, 2021) (3,4). Reports have also described congenital bands causing duodenal obstruction, highlighting the importance of thorough intraoperative exploration (Xiong et al., 2025) (11).

Postoperative complications in the present study were relatively low, with most patients experiencing an uneventful recovery. Septic shock and respiratory distress were observed in a small proportion of cases, particularly among patients presenting with advanced disease. Severe infections and sepsis remain significant contributors to morbidity and mortality in pediatric surgical emergencies (Hotchkiss et al., 2016) (19). However, improvements in neonatal intensive care, surgical techniques, and perioperative management have significantly enhanced survival rates in recent years (Taha et al., 2023) (10).

The overall survival rate in the present study was high, with mortality occurring only in a patient with gangrenous bowel and septic shock. The findings indicate that bowel viability at the time of surgery plays a crucial role in determining patient outcomes. Early diagnosis and timely surgical intervention are therefore essential to prevent progression to bowel necrosis and reduce mortality. Similar conclusions have been reported in previous studies, which emphasize the importance of early detection and prompt management in improving survival among pediatric patients with abdominal surgical emergencies (Tayade et al., 2022; Saberi et al., 2022) (1,23).

CONCLUSION

This case series highlights the wide clinical spectrum of intestinal malrotation and associated congenital intestinal pathologies across neonatal, infant, and pediatric age groups. Bilious vomiting in neonates and acute obstructive symptoms in older children were the most consistent presenting features, underscoring the need for high clinical suspicion and urgent evaluation. Ladd's procedure formed the cornerstone of surgical management and was associated with excellent outcomes when performed before the onset of bowel ischemia. Cases with viable bowel at exploration demonstrated complete recovery, even in the presence of obstruction or localized perforation. In contrast, delayed presentation leading to gangrenous bowel and septic shock was associated with mortality, emphasizing the critical importance of early diagnosis and timely intervention. Overall, prompt surgical correction combined with appropriate perioperative care resulted in favorable outcomes in the majority of patients. Early recognition of warning signs remains essential to prevent avoidable morbidity and mortality in pediatric intestinal emergencies.

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