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ORIGINAL ARTICLE

Surgical Outcomes of Intussusception with Intestinal Perforation in the Pediatric Population: A Six-Year Prospective Study

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ABSTRACT

Background: Intussusception is a leading cause of intestinal obstruction in children. While most cases respond to non-operative reduction, perforation remains a rare but devastating complication with high morbidity and mortality. Prospective data on disease-related perforated intussusception from resource-limited settings are scarce.

Objective: To evaluate surgical outcomes, complications, and prognostic factors in children with perforated intussusception.

Methods: A prospective study was conducted at the Department of Pediatric Surgery, Liaquat University Hospital, Hyderabad, Pakistan (December 2015–December 2021). Children aged 2 months to 12 years with confirmed intussusception and intestinal perforation requiring surgery were enrolled. Logistic regression identified independent mortality predictors.

Results: Forty-two children (mean age 18.6±14.2 months; 64.3% male) were included. Mean symptom duration was 4.2±1.8 days, with 66.7% presenting beyond 72 hours. Bowel resection with primary anastomosis was performed in 78.6%; pathological lead points were identified in 38.1%. Postoperative complications occurred in 61.9%, including surgical site infection (35.7%), sepsis (21.4%), and anastomotic leak (14.3%). Mean hospital stay was 14.8±6.4 days. Mortality was 11.9%. Independent mortality predictors included delayed presentation >72 hours (OR 4.8; p=0.025), septic shock on admission (OR 12.6; p=0.001), bowel necrosis >30 cm (OR 8.4; p=0.005), and anastomotic leak (OR 7.2; p=0.018).

Conclusion: Perforated intussusception carries substantial morbidity and mortality. Delayed presentation is the most critical modifiable risk factor; early recognition and prompt intervention are essential.

Keywords: Intussusception, intestinal perforation, pediatric surgery, surgical outcomes, bowel resection.

INTRODUCTION

Intussusception ranks as the most common cause of intestinal obstruction in infants and young children, with an estimated global incidence of one to four cases per 1,000 live births[1,2]. In contemporary high-resource settings, the majority of cases are managed successfully through non-operative enema reduction techniques, either pneumatic or hydrostatic, with success rates frequently exceeding 80%[3]. Nevertheless, when diagnosis is delayed or reduction fails, surgical intervention becomes necessary, and outcomes worsen considerably.

Intestinal perforation constitutes a particularly severe complication of intussusception and arises through two distinct mechanisms. Iatrogenic perforation may occur during enema reduction, with meta-analyses documenting rates of approximately 0.4% for both air and liquid enemas across large pooled cohorts [3]. Contemporary single-centre experiences corroborate these low rates, reporting perforation incidences ranging from 0.5% to 1.9% in well-resourced tertiary centres[4–6]. In contrast, disease-related perforation develops when prolonged bowel ischaemia progresses to transmural necrosis, typically in the context of delayed presentation or misdiagnosis. This mechanism predominates in resource-constrained environments where access to timely imaging and reduction is limited.

Geographic disparities in perforation rates are striking. In South Africa, a nine-hospital cohort revealed that 20% of operatively managed intussusception cases had perforated bowel at surgery, with resection required in 61% of surgical patients[7]. Ethiopian data similarly document high postoperative complication rates (26%) and mortality approaching 9–13% in settings where non-operative reduction is largely unavailable[8]. Nigerian series identify intussusception as the leading indication for paediatric bowel resection, with associated mortality of 5.5% and substantial long-term morbidity[9,10]. These findings contrast sharply with the near-zero mortality reported after iatrogenic perforation in centres equipped for immediate decompression and rapid operative access[11,12].

Despite the considerable burden of disease-related perforation in developing regions, prospective data remain limited. Most available literature consists of retrospective reviews embedded within broader surgical series, often with inconsistent outcome reporting and inadequate analysis of prognostic factors. This prospective study addresses this evidence gap by examining surgical outcomes, complications, and predictors of mortality in children with disease-related perforated intussusception at a major tertiary referral centre in Pakistan.

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MATERIALS AND METHODS

We conducted a prospective observational study at the Department of Pediatric Surgery, Liaquat University Hospital (LUH), Hyderabad, Pakistan, from December 2015 to December 2021. LUH serves as a tertiary referral centre for paediatric surgical emergencies across Sindh Province. Children aged 2 months to 12 years with confirmed intussusception and intestinal perforation (pneumoperitoneum on imaging or intraoperative visualisation) requiring surgical intervention were enrolled. Exclusion criteria included intussusception without perforation, incomplete records, and refusal of consent. Based on an estimated 2% perforation rate and 15% projected mortality, a minimum sample size of 35 patients was calculated (95% confidence, 80% power). The written informed consent was obtained from all guardians.

A standardised proforma captured demographic, clinical, radiological, surgical, and outcome data. Follow-up was conducted at three months post-discharge. Delayed presentation was defined as symptoms exceeding 72 hours; septic shock as hypotension requiring vasopressors; surgical site infection per CDC criteria; and anastomotic leak as clinical or radiological evidence of dehiscence.

Preoperative management comprised aggressive resuscitation, nasogastric decompression, broad-spectrum antibiotics, and electrolyte correction. All patients underwent exploratory laparotomy. Non-viable bowel was resected with primary anastomosis; small perforations with viable bowel received manual reduction and primary repair; stoma formation was reserved for extensive contamination or haemodynamic instability.

Data were analysed using SPSS version 26.0. Continuous variables were expressed as mean±standard deviation; categorical variables as frequencies and percentages. Logistic regression identified independent mortality predictors. Statistical significance was set at $p<0.05$.

RESULTS

During the study period, 348 children were diagnosed with intussusception at our institution, of whom 42 (12.1%) presented with intestinal perforation. Mean age was 18.6±14.2 months, with male predominance (64.3%). Most patients (69.0%) resided in rural areas, and 61.9% were malnourished (Table 1).

Mean symptom duration was 4.2±1.8 days, with 66.7% presenting beyond 72 hours. All patients exhibited abdominal pain and peritoneal signs; abdominal distension was present in 90.5%. The classic triad of abdominal pain, palpable mass, and bloody stools occurred in only 21.4%. Septic shock was documented in 33.3% at admission (Table 2).

Leukocytosis was common (mean $16.8\times10^3/\mu L$). Pneumoperitoneum was detected on abdominal radiography in 73.8%. Ultrasound was performed in 83.3% of cases, demonstrating the target sign in 80.0% and free fluid in 94.3%. Median time from admission to surgery was 6.2±3.4 hours. Ileocolic intussusception predominated (83.3%). Pathological lead points were identified in 38.1%, most commonly Meckel's diverticulum (16.7%). Severe peritoneal contamination was present in 35.7%. Perforation sites included the ileum (73.8%), caecum (16.7%), and colon (9.5%). Extent of bowel necrosis was less than 10 cm in 28.6%, 10–30 cm in 50.0%, and greater than 30 cm in 21.4%. Bowel resection with primary anastomosis was performed in 78.6%, with mean resected length of 18.4±12.6 cm. Manual reduction with primary repair was undertaken in 21.4%. Stoma creation was necessary in 14.3% due to severe contamination or haemodynamic instability (Table 3).

The overall complication rate was 61.9%. Surgical site infection occurred in 35.7%, sepsis in 21.4%, wound dehiscence in 19.0%, and anastomotic leak in 14.3% (Figure 1). Intensive care admission was required in 76.2%, with mean ICU stay of 5.8±3.4 days. Reoperation was necessary in 21.4%. Mean hospital stay was 14.8±6.4 days (Table 4).

Mortality was 11.9% (five patients). Primary causes were septic shock (60%), multi-organ failure (20%), and anastomotic leak with peritonitis (20%). Multivariate analysisi identified four independent mortality predictors: delayed presentation exceeding 72 hours (OR 4.8; 95% CI 1.2–18.4; p=0.025), septic shock on admission (OR 12.6; 95% CI 2.8–56.2; p=0.001), extensive bowel necrosis greater than 30 cm (OR 8.4; 95% CI 1.9–37.1; p=0.005), and anastomotic leak (OR 7.2; 95% CI 1.4–36.8; p=0.018) (Table 5).

Table 1. Demographic Characteristics (n=42)

Variables	N (%) or Mean±SD
Age (months)	18.6±14.2
Age 2-6 months	8 (19.0)
Age 7-12 months	14 (33.3)
Age 13-24 months	12 (28.6)
Age > 24 months	8 (19.0)
Male	27 (64.3)
Female	15 (35.7)
Rural Residence	29 (69.0)
Malnourished	26 (91.9)
Wright (kg)	9.4±3.2

Table 2. Clinical Features (n=42)

Feature	n (%)
Symptoms duration (days)	4.2±1.8
Duration < 24 hours	3 (7.1)
Duration 24-72 hours	11 (26.2)
Duration >72 hours	28 (66.7)
Abdominal Pain	42 (100)
Vomiting	40 (95.2)
Abdominal distension	38 (90.5)
Bloody Stool	22 (52.4)
Fever	31 (73.8)
Peritoneal signs	42 (100)
Palpable mass	19 (45.2)
Septic shock	14 (33.3)

Of 37 survivors, 34 (91.9%) completed three-month follow-up. Normal growth and bowel function were observed in 91.2%. Two patients developed recurrent adhesive obstruction managed conservatively; one required incisional hernia repair. All six patients with initial stomas underwent successful closure at a mean of 12.4±3.2 weeks.

Table 3. Surgical Procedures (n=42)

Procedure	n (%)
Bowel resection + Primary Anastomosis	33 (78.6)
Manual Reduction + Primary Repair	9 (21.4)
Stoma Creation	6 (14.3)
Mean resection length (cm)	18.4±12.6

Table 4. Postoperative Outcomes (n=42)

Outcome	N (%) or Mean±SD
ICU Admission	32 (76.2)
ICU Stay (days)	5.8±3.4
Hospital stay (days)	14.8±6.4
Total Complications	26 (61.9)
Surgical site infection	15 (35.7)
Wound dehiscence	8 (19.0)
Anastomotic Leak	6 (14.3)
Sepsis	9 (21.4)
Reoperation	9 (21.4)

Table 5. Independent Predicators of Morality

Factors	Odds Ratio	95 % CI	p-value
Presentation > 72 hours	4.8	1.2 – 18.4	0.025
Septic shock on admission	12.6	2.8 – 56.2	0.001
Bowel necrosis > 30 cm	8.4	1.9 – 37.1	0.005
Anastomotic Leak	7.2	1.4 – 36.8	0.018

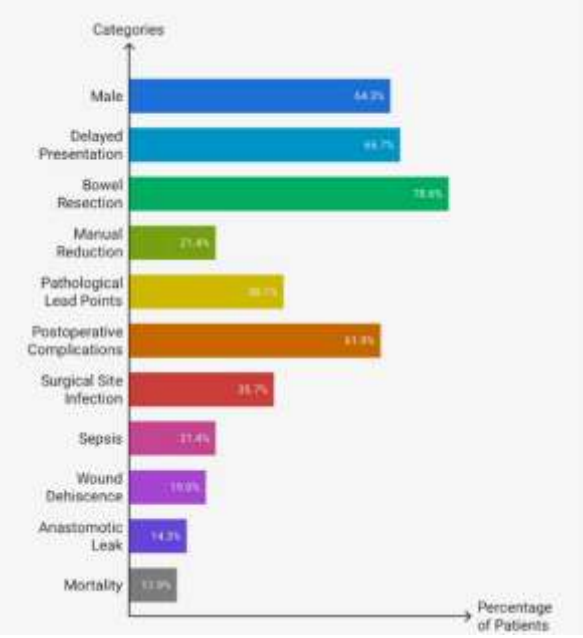

Figure 1: Outcomes and Predictors in Perforated Intussusception

DISCUSSION

This prospective study of 42 children with disease-related perforated intussusception demonstrates a perforation rate of 12.1% among all intussusception cases presenting to our institution markedly higher than the 0.4–0.6% iatrogenic perforation rate documented during enema reduction in high-resource settings[3,11]. This disparity underscores the profound impact of delayed presentation in our region, where two-thirds of patients arrived beyond 72 hours of symptom onset. Our mortality rate of 11.9% and complication rate

of 61.9% align closely with reports from comparable resource-limited environments[7–10].

The distinction between iatrogenic and disease-related perforation carries critical prognostic implications. Iatrogenic perforation during enema reduction typically results from pressure-related colonic rupture distal to the intussusceptum and, when promptly recognised and managed with percutaneous decompression, carries favourable outcomes with no excess mortality[11,12]. Contemporary series report that immediate needle decompression of tension pneumoperitoneum, followed by expeditious laparotomy, yields excellent survival even when resection is required[11,12]. In contrast, disease-related perforation develops insidiously as prolonged venous congestion progresses to arterial compromise and transmural necrosis a process requiring time and explaining the pivotal role of presentation delay in determining outcomes.

Our findings are consistent with published data from sub-Saharan Africa. Cox and colleagues reported that 20% of operatively managed intussusception cases in South Africa had perforated bowel, with resection required in 61% and overall mortality of 1% in a system with earlier access to surgical care[7]. Ethiopian data document postoperative complication rates of 26% and mortality approaching 9%, attributable to delayed presentation and limited availability of non-operative reduction[8]. Nigerian series similarly identify intussusception as the leading indication for paediatric bowel resection, with postoperative complications in 41% and mortality of 5.5%[9,10]. These consistent findings across resource-limited settings highlight the global disparity driven by healthcare access and presentation timing.

The mean age of our cohort (18.6 months) exceeded the typical intussusception peak of 6–9 months, consistent with observations that older children experience atypical presentations predisposing to diagnostic delays[4,13]. The infrequent occurrence of the classic triad (21.4%) further reflects the altered clinical picture following perforation, wherein peritonitis dominates the presentation.

Our multivariate analysis identified four independent mortality predictors with direct clinical implications. Delayed presentation beyond 72 hours emerged as the strongest modifiable factor (OR 4.8), present in 66.7% of our cohort and directly linked to disease progression. Published evidence confirms that pre-hospital delays, rather than short in-hospital delays, drive adverse outcomes[14,15]. This finding underscores the urgent need for community education, primary care training, and improved emergency transport infrastructure.

Septic shock on admission (OR 12.6) served as a marker of advanced physiological derangement requiring aggressive preoperative resuscitation. Elevated lactate levels have been identified as predictors of poor outcomes in paediatric intussusception, suggesting potential utility for risk stratification[16]. Extensive bowel necrosis exceeding 30 cm (OR 8.4) reflects disease severity and increases the technical challenge of achieving a safe anastomosis. Our anastomotic leak rate of 14.3% falls within the 8–20% range reported for emergency paediatric bowel resection, with three of six leaks proving fatal, emphasising the need for meticulous surgical technique, adequate perfusion assessment, and judicious use of protective stoma in high-risk cases[9,10].

The high prevalence of pathological lead points (38.1%) in our cohort substantially exceeds the 5–10% reported in uncomplicated intussusception, suggesting that lead points may contribute to diagnostic delay and treatment failure. This observation mandates thorough intraoperative inspection and routine histopathological examination of resected specimens.

Several system-level factors merit consideration. Paediatric specialty care has been associated with lower bowel resection rates and reduced complications even when severe disease is prevalent, suggesting that standardised pathways and expertise improve outcomes[17]. Ultrasound-guided hydrostatic reduction, where available, achieves high success rates with fewer complications than fluoroscopy-guided air reduction, offering a potential strategy for preventing progression to perforation[18].

This study possesses several strengths, including its prospective design minimising recall bias, standardised management protocols, complete outcome data with three-month follow-up, and multivariate analysis identifying independent predictors. Limitations include single-centre design potentially limiting generalisability, although LUH serves a major referral population. The three-month follow-up may miss longer-term complications. The absence of a non-perforated operative control group limits direct comparison of perforation-specific outcomes.

CONCLUSION

Disease-related perforated intussusception carries substantial morbidity (61.9%) and mortality (11.9%) in this paediatric population, driven primarily by delayed presentation. Our perforation rate of 12.1% dramatically exceeds the 0.4–0.6% iatrogenic perforation rate documented in high-resource settings, highlighting the critical importance of early recognition and timely referral. Independent predictors of mortality include delayed presentation beyond 72 hours, septic shock, extensive bowel necrosis, and anastomotic leak. The most impactful intervention lies in reducing pre-hospital delays through community education, healthcare worker training, and system strengthening. Establishing accessible non-operative reduction services and ensuring prompt surgical capability remain essential to reduce the burden of this preventable complication.

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