

# Risk Factors for Operative Treatment of Intussusception: A Single Centre Study in Low-and middle- income country Perspective

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## Abstract

**Introduction:** Although, non-operative treatment is a well-established method of treatment of intussusception, surgical intervention is still needed in some patients. Early recognition of these patients can reduce morbidity and mortality. The aim of the study was to find out the risk factors for surgery in these patients. **Subjects and Methods:** A retrospective analysis was performed among 225 patients of intussusception in a tertiary government teaching hospital between 2016 and 2019. Patients were evaluated for demographic features, presenting features with duration, examination findings, attempt for hydrostatic reduction, success and failure of hydrostatic reduction, type of surgery and mortality. Logistic regression analysis was performed to find out the risk factors. **Results:** Male to female ratio was 2.2:1, age ranged from 1.5 months to 8 years (median 8 months) and median weight was 8 kg. Duration of symptoms ranged from 1 to 14 days (mean 2.61 days). Hydrostatic reduction was attempted in 141 (62.7%) patients and was successful in 125 (88.7%) patients. 100 (44.4%) patients underwent surgery. The risk factors for surgery were symptoms >48 hours (P<0.01), abdominal distension (P=0.01), per rectal bleeding (P=0.03), constipation (P<0.01), raised temperature (P=0.01), palpable abdominal mass (P=0.01) and presence of red currant jelly (P=0.04). Surgeries performed were manual reduction (65), intestinal resection anastomosis (18), intestinal stoma (13) and intestinal resection anastomosis with proximal stoma (4). There were 6 (2.7%) mortalities, all after surgery. **Conclusion:** The identified risk factors for surgery may help in the early and prompt referral of patients with intussusception.

**Keywords:** Intussusception, Surgery, Risk Factors, Children.

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## Introduction

Intussusception is the most common cause of acute abdomen in infants with a peak incidence at age 6–9 months.<sup>[1,2]</sup> Most cases are idiopathic and can be managed conservatively if presented early by non-operative reduction via pneumatic or hydrostatic enemas.<sup>[3]</sup> However, if untreated, this may progress to bowel ischemia, necrosis, and perforation.<sup>[2]</sup> Moreover, in the preschool and older children, sometimes a secondary lead point may be found and they may need surgical exploration. Ultrasonographic investigations and sometimes contrast enema are the mainstay for diagnosis of intussusception. Surgical management usually involves laparotomy or laparoscopy with manual reduction of the

intussusception mass. However, if there is a compromise to blood supply of a bowel segment, bowel resection with anastomosis or stoma formation might be needed.<sup>[4]</sup>

Successful management of intussusception consist of early diagnosis, adequate fluid and electrolyte resuscitation, antibiotic therapy and prompt non-operative reduction.<sup>[4]</sup> However, in many low- and middle-income countries there are often delay in the presentation, diagnosis and treatment of intussusception for various socioeconomic, cultural and other factors. This makes a potentially conservatively treatable condition to proceed to advanced phase and often mandates surgery and thus increase the chance of mortality. Moreover, children with intussusception, especially at the earlier ages, may have variable presentations. The classic triad of presentation with vom-

iting, colicky abdominal pain, and red currant jelly stools can be found in less than 50% of patients.<sup>[5]</sup> This may make the diagnosis challenging and may lead to delay in management. Therefore, identification of risk factors for surgery is important to reduce the rate of surgical intervention or avoid bowel necrosis. The aim of this study was to find out the risk factors associated with need for surgical exploration for intussusception in the context of Bangladesh and describe the characteristics and the presence of these risk factors among patients in whom attempt at hydrostatic reduction failed.

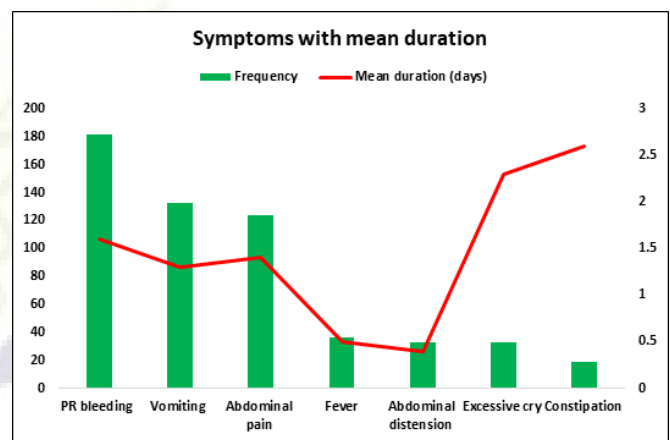
## Subjects and Methods

**Study design and setting:** This study is a component of a large hospital based retrospective study which evaluated success of hydrostatic reduction in the Department of Pediatric Surgery, Chittagong Medical College Hospital, Bangladesh. In the current study, records of all patients of intussusception admitted in this department during a period of 2016 to 2019 were analyzed to find out the risk factors associated with need for surgery in patients with intussusception. Patients' presenting features with duration of symptoms, examination findings, type of treatment and their outcome were recorded. In patients who underwent hydrostatic reduction, diagnosis was confirmed by contrast enema and in those who underwent surgery it was confirmed by per-operative observation. Other cases without the above-mentioned confirmation were excluded. Hydrostatic reduction was performed using water soluble contrast medium by intermittent radiography.<sup>[6,7]</sup>

**Data Analysis:** Data were evaluated for demographic features (age, sex, residence, weight), presenting features with duration, examination findings, whether or not attempt for hydrostatic reduction was taken, success and failure of hydrostatic reduction, need for surgery, type of surgery and mortality. Differences in demography, clinical features and outcome between patients with successful hydrostatic reduction and patients who underwent surgery were analyzed using Student's t or Mann-Whitney U test for numerical data (age, weight, distance from hospital, duration of symptoms, pulse, temperature and hospital stay) and using Chi-square test or Fisher's exact test for categorical data (sex, presenting features, examination findings, mortality). Binary logistic regression analyses were performed for risk factors for surgery in demographic, symptomatic, examination findings. Variables in patients who underwent failed hydrostatic reduction were analyzed separately to observe the characteristics. As a secondary objective, risk factors for bowel ischemia were also analyzed using binary logistic regression analyses. Data were analyzed using Microsoft Excel 2019 and SPSS version 22. Data were expressed as frequency and percentage. This study was approved by the Ethical Review Committee of Chittagong Medical College (Memo no-CMC/PG/2020/102).

## Results

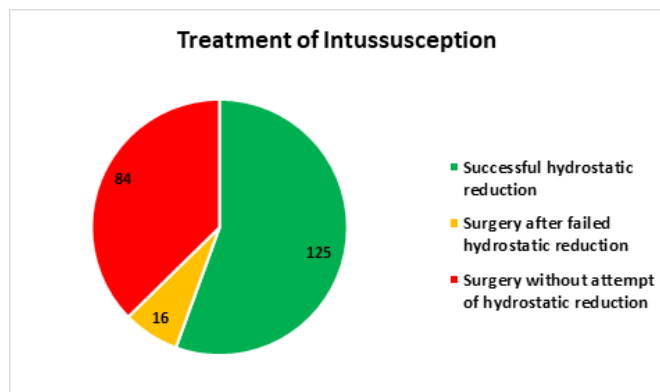
Among a total of 225 patients, 154 were male and 71 were female (ratio 2.2:1). Age ranged from 1.5 months to 8 years, mean  $11.8 \pm 12.5$  months, median 8 months, IQR 6-11.5 months. Median weight was 8 kg (IQR 6.5-9 kg). Per rectal bleeding (182, 80.9%) was the most common presentation followed by vomiting (133, 59.1%) and abdominal pain (124, 55.1%) [Figure 1]. Duration of symptoms ranged from 1 to 14 days (mean 2.61 days). The most common examination findings were tachycardia (137, 60.9%), presence of red currant jelly on DRE (88, 39.1%) and abdominal distension (77, 34.2%). USG could comment about intussusception in 177 (78.7%) patients. In 21 patients, no USG was performed; in 3 patients, USG commented about intestinal obstruction; and in 24 patients, the findings of USG were not recorded.



**Figure 1: Presenting feature and their mean duration (N=225)**

Hydrostatic reduction was attempted in 141 (62.7%) patients and among them, it was successful in 125 (88.7% of the attempted and 55.5% of all) patients. A total of 100 (44.4%) patients underwent surgery in whom hydrostatic reduction was initially attempted in 16 (7%) patients [Figure 2]. Among the patients who underwent surgery, 65 had manual reduction of intussusception, 18 had intestinal resection anastomosis, 13 had intestinal stoma and 4 had intestinal resection anastomosis with proximal stoma. In total, 6 (2.7%) patients died, all after surgery. Among the 16 patients in whom hydrostatic reduction failed, 12 underwent open manual reduction, 1 laparoscopic reduction and 3 exteriorizations of gut. One of them died.

Per rectal bleeding, vomiting, abdominal distension and constipation were significantly more among patients who underwent surgery [Table 1]. Mean duration of symptoms among patients in whom hydrostatic reduction was attempted was 2.2 days (median 2 days). Among them, patients with successful reduction had mean symptom duration of 2.1 days



**Figure 2: Frequency of patients with underwent successful and failed hydrostatic reduction and surgery (N=225)**

(median 1 day) and that with failed reduction 2.8 days (median 2 days). Patients who underwent surgery also had significantly longer duration of symptoms [Table 1]. Mean duration of symptoms among patients who developed bowel necrosis (n=35) was 3.5 days (median 3 days). On examination, patients who underwent surgery had significantly more cases of raised temperature, abdominal mass, tenderness and distension [Table 1].

Regression analyses showed that symptom duration of more than 48 hours, abdominal distension, history of per rectal bleeding and constipation are significant risk factors of symptoms for need for surgery [Table 2]. Raised temperature, palpable abdominal mass and presence of red currant jelly were significant examination findings as risk factors for need for surgery (Table 2). Risk factors for bowel necrosis was weight <10 kg (P=0.03), abdominal mass (P=0.03) and increased symptom duration (P=0.01).

All the 16 patients who had failed hydrostatic reduction presented with per rectal bleeding. Majority had abdominal pain and vomiting and none had fever [Table 3]. However, red currant jelly was found on DRE in 9 (56.3%) patients.

## Discussion

Over the last few decades, there have been major changes in the algorithms of management of intussusception. Ultrasonography is available everywhere and can effectively and widely diagnose the disease, previously perceived contraindications for enema reductions no longer apply, safer contrast media or gas are used for reduction instead of barium for hydrostatic or pneumatic reduction, and a delayed repeat enema is attempted in a clinically stable child after an initial failed attempt. All these efforts significantly reduced the need for surgery in patients with intussusception. Moreover, laparoscopy reduced the surgical morbidity should surgery be needed.<sup>[8]</sup> A 20-year

population-based cohort study from Canada showed that pre-treatment imaging use rose from 57.5% to 99.3% and non-operative management increased from 23.4% to 75.2%. However, as many as 43% of children who presented to a community hospital underwent immediate surgical management, in contrast to 11% at tertiary centres.<sup>[9]</sup> Unfortunately, in many low- and middle-income countries, still a large majority of patients undergo surgical intervention for the treatment of intussusception whether or not the facilities for non-operative reduction are available. This study evaluated the risk factors for need for surgery in these patients in a lower-middle-income country perspective.

Delayed presentation, abdominal distension, per rectal bleeding, constipation, raised temperature, palpable abdominal mass and presence of red currant jelly were significant risk factors for surgery in this study. All these are related to progression of disease process. Xiaolong et. al. analysed risk factors for failed reduction and in their study, age of under 1-year-old, a duration of symptoms of more than or equal to 48h, rectal bleeding, constipation, palpable abdominal mass and location of mass (left over right side) were significant risk factors.<sup>[10]</sup> In their institute the success rate for hydrostatic reduction was 96.77%.<sup>[11]</sup> Success rate in the current study was 88.7%, which is comparable to both hydrostatic and pneumatic reduction method around the world.<sup>[12,13]</sup> This rate is much higher than some studies from developing countries who had a 41%-44.7% success rates.<sup>[14,15]</sup> One of the reasons for a relatively lower success rate in this study than some other studies may be due to the increased threshold for duration of symptoms for attempting hydrostatic reduction. Median duration of symptoms before presentation was 25 hours in their study whereas, it was 2 days in this study. Binkovitz et. al. and Tareen et. al. found that successful reductions were not related to symptom duration. However, in their series also, mean duration of symptoms was 33 hours and 18.5 hours, respectively; which implies that majority of the patients presented early.<sup>[1,16]</sup>

Delayed presentation of surgical condition is a common scenario in the many low- and middle-income countries which is a result of several socio-economic, religious and cultural factors. In this study hydrostatic reduction could be attempted in 62.7% of the patients, meaning, a large portion of the patients presented in a state when hydrostatic reduction was not a safe option to consider. There was significant delay in presentation in these patients in contrast to the patients who underwent successful hydrostatic reduction. Veli et. al. also reported that mean symptom duration was 2.74 days in the patients with successful reduction and 4.33 days in the patients with failed reduction.<sup>[17]</sup> In a study from 7 Sub-Saharan African countries, median duration of symptoms prior to hospitalization was 3 days and 85% of the 1017 children included in that study needed surgical treatment.<sup>[18]</sup> Moreover, it has been shown by Blackwood et. al. that the amount of

**Table 1: Differences in demography, clinical features and outcome between patients with successful hydrostatic reduction vs surgery**

	Successful Hydrostatic reduction (n=125)	Surgery (n=100)	P value
<b>Demography</b>			
• Mean age ± SD (months)	12.0 ± 12.8	11.6 ± 12.3	0.52
• Median age (months)	8 (IQR 6-11.5)	7.5 (IQR 6-11.75)	0.5
• Mean distance of residence (km)	80.8	81.5	0.93
• Mean weight (kg)	8.1	8.1	0.98
• Median weight (kg)	8	7.8	0.48
• Female sex	39 (31.2)	32(32.0)	0.9
<b>Presentation</b>			
• PR bleeding	95 (76.0)	87 (87.0)	0.03
• Vomiting	67 (53.6)	66 (66.0)	0.03
• Abdominal pain	68 (54.4)	56 (56.0)	0.26
• Fever	17 (13.6)	19 (19.0)	0.27
• Abdominal distension	8 (6.4)	25 (25.0)	<0.01
• Excessive cry	24 (19.2)	9 (9.0)	0.33
• Constipation	7 (5.6)	12 (12.0)	0.07
• Other symptoms	7 (5.6)	9 (9.0)	0.23
• Mean duration of symptoms (days)	2.1	3.2	<0.01
<b>Symptoms</b>			
• <24 hours	63 (50.4)	22 (22.0)	
• 24-48 hours	22 (17.6)	22 (22.0)	<0.01
• >48 hours	40 (32.0)	56 (56.0)	
<b>Examination</b>			
• Pulse (beats/minute)	101.6	99.8	0.4
• Temperature (° F)	98.6	99	0.03
• Abdominal mass	17 (13.6)	29 (29.0)	<0.01
• Abdominal tenderness	31 (24.8)	41 (41.0)	0.01
• Abdominal distension	28 (22.4)	49 (49.0)	<0.01
• Red currant jelly	43 (34.4)	46 (46.0)	0.33
<b>Outcome</b>			
• Mean hospital stay (days)	3	9.15	<0.01
• Death	0	6 (6.0)	<0.01

Values represent frequency (%) unless otherwise specified. P value derived from Student's t, Mann-Whitney U, Chi-square tests.

time patients spend at hospitals without paediatric surgical facilities is an independent risk factor for surgery.<sup>[18]</sup> Intestinal viability was lost in 35 (15.6%) patients in this study. A study from China found a 24% loss of intestinal viability among 316 patients and female, length of history and ileo-ileal intussusception was the risk factors for loss of intestine viability in their series.<sup>[19]</sup>

Less than one year of age was found to be a risk factor for failed reduction or surgery in several studies.<sup>[10,20]</sup> It

was suggested that radiologists were less willing to attempt aggressive reduction in infants and thereby increased the risk of failed reduction. In this study age was not a significant risk factor. Among the two classic symptoms of vomiting and colicky abdominal pain, none was a significant risk factor for surgery in this study. On the other hand, both the classic signs of rectal bleeding and abdominal mass were significant risk factors in this study. This is consistent with other studies also.<sup>[10,15,20,21]</sup> Female sex has been shown to be a risk factor for loss of bowel viability.<sup>[19]</sup> In this study, female sex was not



**Table 2: Significant risk factors for need for surgery**

Risk factors	P value	OR	95% C.I. for EXP(B)	
			Lower	Upper
Symptoms > 48 hours	0.00	0.352	0.18	0.71
Abdominal distension	0.01	0.205	0.07	0.63
Per rectal bleeding	0.03	0.276	0.09	0.85
Constipation	0.00	0.11	0.03	0.44
Raised temperature	0.01	0.295	0.13	0.69
Abdominal mass	0.01	0.345	0.15	0.78
Red currant jelly	0.04	2.295	1.06	4.98

a significant risk factor for need for surgery.

Operative rate of 44.4% in this study is less than that of an African report of seven countries where more than 87% of a total of 1158 cases underwent surgery.<sup>[22]</sup> However, it was more than that of many developed countries. On the other hand, a recent US National Inpatient Sample Database analysis found that out of 21,835 intussusception hospitalizations over a period of 10 years, 66% had surgical intervention, 90% of which had no preceding enema.<sup>[23]</sup> This implies that the use of non-operative reduction is yet to be generalised in all centres globally. Among the patients who underwent surgery in this study, 35% had bowel compromise and needed excision of some part of the bowel. This is comparable to a study from Ethiopia (29.8%) but much higher than the US series (10.9%).<sup>[23,24]</sup>

Mortality in this study was 2.7%. Although, this mortality rate is higher than many developed countries, it was much lower than reports from many African countries. Akello et. al. reported a mortality rate as high as 32% in Uganda.<sup>[25]</sup> Pindyck et. al. reported a mortality rate of 13 % from 7 sub-Saharan African countries. They analysed risk factors associated with increased mortality in these infants and found that female sex, longer duration of symptoms prior to presentation and undergoing intestinal resection were associated with death after intussusception. They also found that diagnosis by ultrasound or enema and employment of a household member were protective against intestinal resection.<sup>[26]</sup> Chalya et. al. reported 14.3% mortality in Tanzania and age < 1-year, delayed presentation, associated peritonitis, bowel resection and surgical site infection were the main predictors of mortality in their series.<sup>[27]</sup>

This study has some limitations. It has all the limitations of a retrospective study. Some factors such as location of intussusception mass, number of attempts of reduction, lead point of intussusception, fluid and bowel thickness on ultrasound and pathology of the resected specimen could not be analysed due to inadequate data entry. Nonetheless, this study could highlight some risk factors pertinent to low- and middle-income country situation and will help to seek

attention to the need for early diagnosis and treatment of intussusception.

## Conclusion

This analysis from a tertiary paediatric surgical facility found that a delay in presentation of more than 2 days, abdominal distension, per rectal bleeding, constipation, raised temperature, palpable abdominal mass and presence of red currant jelly are significant risk factors for surgery in patients of intussusception. Patients with these findings should be referred to centres who have the ability for non-operative reduction and surgery as early as possible to reduce morbidity and mortality.

## Ethical approval:

This retrospective chart review study involving human participants was in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The ethical review committee of Chittagong Medical College approved this study (memo no: CMC/PG/2020/102).

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Table 3: Characteristics of patients with failed hydrostatic reduction (N=16)

Characteristics	Failed hydrostatic reduction
<b>Demography</b>	
• Mean age $\pm$ SD (months)	7.2 $\pm$ 3.2
• Median age (months)	7(IQR 5-7.75)
• Mean distance of residence $\pm$ SD (km)	62.9 $\pm$ 45.5
• Mean weight (kg)	7.4 $\pm$ 1.3
• Median weight (kg)	7.25 (IQR 6.1-8)
• Female sex	4 (25.0)
<b>Presentation</b>	
• PR bleeding	16 (100.0)
• Vomiting	11 (68.8)
• Abdominal pain	11 (68.8)
• Fever	0 (0.0)
• Abdominal distension	2 (12.5)
• Excessive cry	2 (12.5)
• Constipation	2 (12.5)
• Other symptoms (H/o chicken pox)	1 (6.3)
• Mean duration of symptoms (days)	1.4
• Symptoms	
• <24 hours	6 (37.5)
• 24-48 hours	5 (31.3)
• >48 hours	5 (31.3)
<b>Examination</b>	
• Pulse (beats/minute)	100
• Temperature ( $^{\circ}$ F)	98.4
• Abdominal mass	4 (25.0)
• Abdominal tenderness	5 (31.3)
• Abdominal distension	3 (18.8)
• Red currant jelly	9 (56.3)
<b>Outcome</b>	
• Median Hospital stay (days)	7 (IQR 5-10)
• Death	1 (6.3)

Values represent frequency (%) unless otherwise specified.

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