

A Study of Predictors of Failure of Nonoperative Management of Ileocolic Intussusception in Children

Jibreel Y Shah¹, Imad Banday², Hanna Z Hamdani³, Mohd Fazlul Haq⁴, Fazl Q Parray⁵, Meeran Banday⁶, Gowhar Aziz Bhat⁷

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ABSTRACT

Background: Surgery remains the mainstay in treating intussusception in developing nations. A correspondingly high bowel resection rate exists despite a shift to nonoperative reduction in high-income countries. We aimed to study the clinical profile of the patients with intussusception presenting to our hospital and to assess the clinical and radiological predictors of success or failure of nonoperative management of intussusception.

Materials and methods: This prospective study was conducted in the Department of Pediatric Surgery over a period of 3 years and included a total of 118 patients who presenting to our emergency division with features suggestive of intussusception and were managed accordingly either with hydrostatic reduction or by surgical intervention.

Results: We observed that the majority of the patients were males (65.5%). The mean age was 13.54 months. Intermittent pain was the most common symptom. Both pain and vomiting did not affect the outcome. Lab parameters like raised total leukocyte counts (TLC), C-reactive protein (CRP) and lactate levels were significantly associated with failure of hydrostatic reduction. Patients with air fluid levels on X-ray were more likely to end up in surgery. Ultrasound findings of bowel wall edema, aperistaltic gut loops and a pathological lead point was associated with failure of hydrostatic reduction as well. The overall success rate of hydrostatic reduction was 85.5%.

Conclusion: Hydrostatic reduction of intussusception is a safe and effective method of management of intussusception whenever indicated. Factors that might reduce the chance of its success include continuous pain, irritability, tenderness, deranged lab parameters like TLC, CRP and lactate levels, air fluid levels on X-ray, bowel wall edema, aperistalsis and the presence of a lead point.

Keywords: Acute abdomen, Hydrostatic reduction, Intussusception, Outcomes, Pediatric emergency, Pediatric surgery.

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INTRODUCTION

Intussusception is defined as telescoping of proximal bowel segment (intussusceptum) into a distal bowel segment (intussusceptum) along with its associated mesentery, which gets dragged within the invaginated segment leading to venous congestion and edema. This results in ischemia and eventually bowel necrosis, perforation, and peritonitis if left untreated.

It can occur at anywhere in the gut. The incidence of intussusception is more among male children, and the majority of the patients are in the age group of 7–12 months.¹ About 75–90% of cases of intestinal intussusceptions are idiopathic, although in these cases the presence of lymphoid hyperplasia is frequently reported.¹ The worldwide incidence of intussusception ranges from 15 to 300/1,00,000 childrens per year.² Patients with intussusception exhibit abdominal pain, which may wax and wane, vomiting, bloating, and bloody stools. The most common manifestation of intussusception is the abrupt onset of acute, cramping, intermittent, and escalating abdominal pain, which often flares up every 15 to 20 minutes. Patients might not experience any symptoms at all in between episodes. About 50–70% of cases are reported to have gross or occult blood in the stool, and the combination of blood and mucus gives the stool a characteristic reddish jelly look. Upon clinical inspection of Abdomen, a sausage-shaped mass can be palpated in abdomen.

The exact mechanism is not known. Predisposing factors include anatomical lead points like Meckel's diverticulum, GI polyps, hypertrophied Peyer patches, etc. Infectious diseases, trauma,

^{1,2,4,6}Department of General and Minimal Invasive Surgery, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, India

³Department of Radiodiagnosis and Imaging, Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu, India

^{5,7}Colorectal Division, Department of General and Minimal Invasive Surgery, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, India

Corresponding Author: Mohd Fazlul Haq, Department of General and Minimal Invasive Surgery, Sher-i-Kashmir Institute of Medical Sciences, Soura, Srinagar, India, Phone: +91 6005360581, e-mail: fazi0124@gmail.com

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bleeding disorders and cystic fibrosis are also implicated. Based on the anatomical involvement, intussusception can be classified as being ileoileal, ileocolic, colocolic or retrograde. A combination of these types can also exist. Ileocolic is found in about 77% of patients.³ And this is what we have investigated in our study.

The investigation of choice for diagnosis of intussusception is ultrasonography (USG) with a sensitivity between 98 and 100% and a specificity between 88 and 100%.^{1,4}

While as abdominal X-rays have sensitivity between 29 and 50% in diagnosing intussusception.^{1,4}

Treatment includes early fluid resuscitation because most children with intussusception are dehydrated. The child's vital signs are usually normal early in the course of the disease. During episodes of pain, hyper peristaltic rushes may be heard.¹

The available treatment modalities for intussusception are nonsurgical and surgical treatment. The nonsurgical treatment is given to the patient if there is no contraindication (signs of perforation, etc.) and the patient is hemodynamically stable. Nonoperative management of intussusception uses an enema or saline reduction technique. Enema reduction using saline has become the preferred method of reduction of intussusception.

Surgical treatment is the treatment of choice for patients with complications and when non-surgical treatment has failed.

The literature suggested that the success rate of nonsurgical reduction among patients was 46–94%. Initial intussusception located in the descending colon/rectum with the presence of peritoneal fluid/trapped fluid in the intussusception, and bloody stools are associated with failure of non-surgical management.⁴

The treatment of choice for intussusception in children is currently nonsurgical with radiological reduction under sonographic or fluoroscopic control.⁵

However, neither technique has been widely accepted.

There are a vast majority of patients who report with intussusception to our center, therefore, this study is undertaken to study the clinical profile of the patients with intussusception and to study the predictors of failure of nonoperative management of intussusception.

MATERIALS AND METHODS

This prospective study was conducted from 2020 to 2023 in the Department of General and minimal invasive surgery and pediatric surgery of our center and included all children between the ages 6 months and 2 years with a postnatal confirmed diagnosis of ileocolic intussusception by ultrasound. Children with age less than 6 months or more than 2 years, association of major congenital anomalies that would affect outcome, frank peritonitis on presentation and those having other types of intussusception were excluded from our study.

All admitted children underwent baseline investigations which in our setup include a complete blood count (CBC), C-reactive protein (CRP) levels, Blood gas analysis with serum electrolytes, X-ray abdomen and a detailed ultrasound of the abdomen using a GE Logic P6 Ultrasound Machine and linear array (MHZ) probe. The important features noted on USG were the classical doughnut sign, target sign or bull's eye lesion and the pseudokidney sign.

The children were adequately resuscitated and then taken up for hydrostatic reduction after taking a well-informed written consent from the parents. Furthermore, intravenous cefuroxime and metronidazole were administered and all the additional surgical preparations were completed in case the reduction failed or a complication developed during the reduction. A hydrostatic reduction failure was identified as an intussusception that was confirmed on USG and could not be decreased with regular saline. After three attempts, each lasting roughly 3–5 minutes, if the intussusceptum did not reduce or move, the procedure was abandoned. Following a successful reduction, the patient was monitored and discharged only when they tolerated a regular diet. Partially reduced intussusceptions or those that failed to or had complications after three attempts were managed surgically.

Table 1: Comparison of patient characteristics and outcome

Outcome	No. of patients (n)	Mean	Standard deviation	p-value
Age (in months)				
Failure	16	14.31	6.42	0.624
Success	94	13.41	6.79	
Weight (in kg)				
Failure	16	10.2063	1.70664	0.643
Success	94	9.9543	2.05100	
Duration (in hours)				
Failure	16	30.1875	9.53743	0.271
Success	94	27.5745	8.59043	

Hydrostatic reduction failure was defined as intussusception that could not be reduced with normal saline and confirmed on USG. The procedure was abandoned if the intussusceptum failed to reduce/move after three attempts, each lasting about 3–5 minutes. After successful reduction, the patient was kept under observation and discharged only when he/she tolerated a regular diet. The study patients were compared by dividing into two groups: reduced and not reduced group. The clinical features and USG features of intussusception and laboratory parameters in favor of reduction and failure were compared using statistical methods.

RESULTS AND OBSERVATIONS

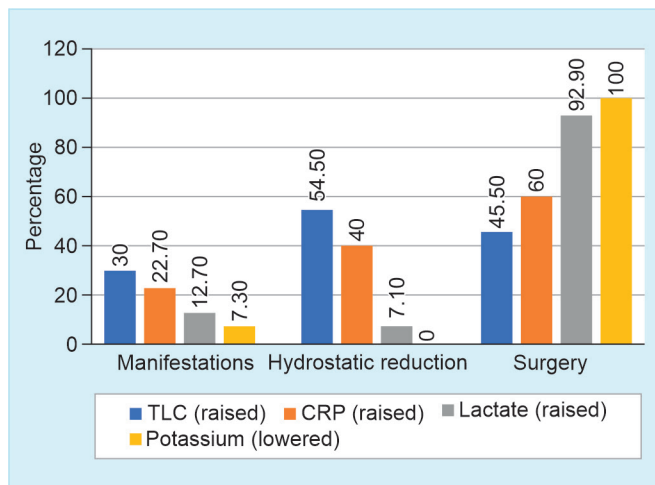
A total of 110 patients were included in the study of which 72 (65.5%) were male and 38 (34.5%) were female. The mean age of presentation was 13.54 months with mean weight of 9.9 kg. Neither weight of the child nor the age or duration of presentation showed any significant difference with regards to treatment outcomes (Table 1).

We observed that a previous episode of intussusception was present in 24 (21.8%) patients in our study. No significant association between this history and the likelihood of nonoperative management was found suggesting that patients with repeated attacks of intussusception can also be managed using nonoperative means. In our study, about 97 (88.2%) patients reported intermittent pain, 13 (11.8%) patients reported continuous pain and 61 patients (55.5%) reported bleeding PR. A significant failure rate was observed in patients who had continuous pain than in those with intermittent pain. About 92.8% of children who had intermittent pain were managed with hydrostatic reduction alone. And 61 (55.5%) patients presented with Bleeding per rectum whereas 49 (44.5%) patients did not report any bleeding PR. Patients without bleeding PR showed significantly higher proportion of success (100%) of nonoperative management than those with bleeding PR (73.8%). Patients without abdominal tenderness showed significantly higher proportion of success (100%) than those with abdominal tenderness (56.8%). Similarly, children with a palpable abdominal lump and distended abdomen also were also more likely to fail nonoperative management ($p < 0.001$) (Table 2).

In our study, 33 (30.0%) patients had raised total leukocyte counts (TLC). Among them, 18 (54.5%) patients resolved with hydrostatic reduction, whereas 15 (45.5%) patients underwent surgery. Raised CRP was reported by 25 (22.7%) patients; among them, 10 (40.0%) patients resolved with hydrostatic reduction and 15 (60.0%) patients underwent surgery. Raised lactate level

Table 2: Comparison of clinical parameters (presentation)s and outcome of nonoperative management

Clinical parameters	Total no. of patients	Outcome of nonoperative management		Statistical results
		Failure	Success	
Earlier episode of intussusception				
Present	24 (21.8%)	5 (20.8%)	19 (79.2%)	Chi-square = 0.976, $p = 0.335$
Absent	86 (78.1%)	11 (12.8%)	75 (87.2%)	
Pain				
Intermittent	97 (88.2%)	7 (7.2%)	90 (92.8%)	Chi-square = 35.469, $p < 0.001$
Continuous	13 (11.8%)	9 (69.2%)	4 (30.8%)	
Bleeding PR				
Present	61 (55.4%)	16 (26.2%)	45 (73.8%)	Chi-square = 15.040, $p < 0.001$
Absent	49 (44.6%)	0	49 (100.0%)	
Abdominal tenderness				
Present	37 (33.6%)	16 (43.2%)	21 (56.8%)	Chi-square = 36.941, $p < 0.001$
Absent	73 (66.4%)	0	73 (100.0%)	
Abdominal lump/distension				
Present	37 (33.6%)	16 (43.2%)	21 (56.8%)	Chi-square = 36.941, $p < 0.001$
Absent	73 (66.4%)	0	73 (100.0%)	

**Fig. 1:** Lab parameters and type of intervention (blue represents the total leucocyte count, orange the CRP levels, Gray represents the lactate levels and yellow the no. of patients with low potassium levels)

was present in 14 (12.7%) patients; among them, 1 (7.1%) patient resolved with hydrostatic reduction and 13 (92.9%) patients had to be operated. Finally, lower potassium level were present in 8 (7.3%) patients; all of them had to be subjected to surgery (Fig. 1, Table 3).

There was a statistically significant association between TLC, CRP, lactate and potassium levels and outcome of nonoperative management ($p < 0.001$). Patients with normal TLC levels showed significantly higher proportion of success (98.7%) than those with raised TLC levels (54.5%), patients with normal CRP levels showed significantly higher proportion of success (98.8%) than those with raised CRP levels (40%), patients with normal lactate levels showed significantly higher proportion of success (96.9%) than those with raised lactate levels (7.1%). Further, patients with normal potassium levels showed 98.7% success, whereas there was no successful outcome (0%) in the case of lowered potassium levels.

In the radiological evaluation, X-ray abdomen showed that 15 (13.6%) patients had air fluid levels; among them, 1 (6.7%) patient was managed with hydrostatic reduction whereas 14 (93.3%) patients underwent surgery. Further, rectal gas was present in 99 (90.0%) patients; among them, 93 (93.9%) patients had hydrostatic reduction and 6 (6.1%) patient underwent surgery (Fig. 2).

Patients without air fluid level showed significantly higher proportion of success (97.9%) than those with air fluid level (6.7%). Similarly, patients with rectal gas (+) showed significantly higher proportion of success (93.9%) than those with rectal gas (-) (9.1%).

Bowel wall edema, gut peristalsis and pathological lead points were evaluated using ultrasound. Bowel wall edema was reported in 37 patients (33.6%); among them, 21 (56.8%) patients had hydrostatic reduction whereas 16 (43.2%) patients had to be subjected to surgery. Aperistaltic gut wall was reported in 21 (19.1%) patients; among them 5 (23.8%) patients resolved with hydrostatic reduction and 16 (76.2%) patients underwent surgery. Lead point was reported in 50 (45.5%) patients; among them, 34 (68.0%) patients resolved with hydrostatic reduction and 16 (32.0%) patients undergone surgery (Fig. 3).

Patients without bowel wall edema showed significantly higher proportion of success (100%) than those with bowel wall edema (56.8%), patients without aperistaltic gut wall showed significantly higher proportion of success (100%) than those with aperistaltic gut wall (23.8%) and patients without lead point showed significantly higher proportion of success than those with a detected lead point.

DISCUSSION

In our study majority of the patients were males (65.5%). The findings were consistent with the study conducted by Ocal S et al. which reported that most of the patients were males (61.1%) followed by 38.9% females.⁷ The mean age of the patients was 13.54 ± 6.7 months, mean weight was 9.9909 ± 1.99947 kg. Our findings were consistent with the observations by John M et al. who found that the mean age of presentation was 17 months and

Table 3: Comparison of biochemical parameters and outcome of nonoperative management

Outcome of nonoperative management	TLC		CRP Levels		Lactate (mmol/dL)		Potassium	
	Normal	Raised	Normal	Raised	Normal	Raised	Normal	Low
No. of patients								
Failure								
<i>n</i>	1	15	1	15	3	13	8	8
%	1.3%	45.5%	1.2%	60.0%	3.1%	92.9%	7.8%	100.0%
Success								
<i>n</i>	76	18	84	10	93	1	94	0
%	98.7%	54.5%	98.8%	40.0%	96.9%	7.1%	92.2%	0.0%

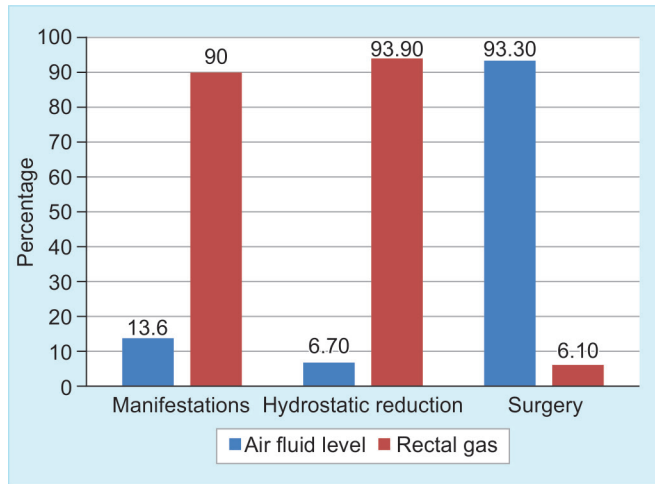


Fig. 2: X-ray findings and type of intervention (blue represents the % of patients with air fluid levels and red represents % of patients with rectal gas)

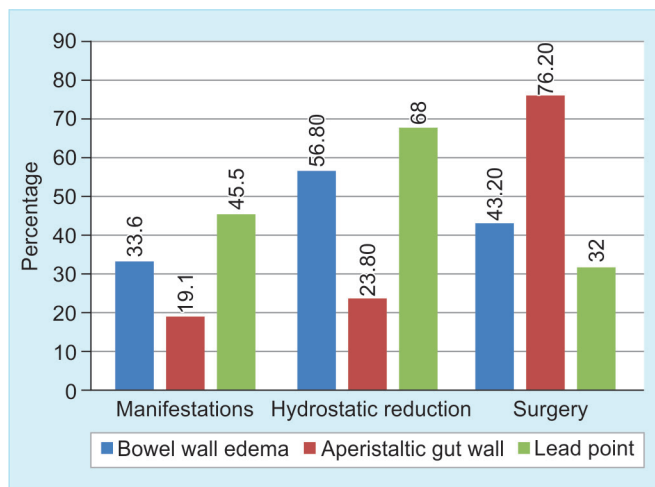


Fig. 3: USG features and type of intervention (blue represents the percentage of pts with wall edema, red the percentage of patients with Aperistaltic gut wall, and green the percentage with a ultrasound detected lead point)

80.2% of children were below 2 years of age, 19.2% were >2 years of age.⁸ However, age did not show to have any significance on the outcome which is in contrast to studies published elsewhere

where younger age on presentation has been associated with more favorable outcomes.⁹ We observed a statistically significant association between type of pain, per rectal bleeding, irritability, abdominal tenderness, presence of lump, abdominal distension, air-fluid level, rectal gas, TLC, CRP, lactate and potassium levels, bowel wall edema, aperistaltic gut wall, presence of a lead point and the outcome of nonoperative management ($p < 0.001$). Most of the patients had intermittent pain (88.2%) followed by continuous pain (11.8%) and 21.8% patients had an earlier episode of intussusception. The spectrum of signs and symptoms observed in our study was similar to that observed by many other authors. Khan TS et al. found that 98.66% of patients had abdominal pain, while distention of the abdomen was the most common (76.88%) manifestation.¹⁰ Similarly, Chalya PL et al. described that 42.5% had a classic triad of bloody stool, vomiting, and abdominal pain.⁶

The present study showed that 15 (13.6%) patients had air fluid levels on X-ray, of which only one patient could be managed with hydrostatic reduction. Further, rectal gas was present in 99 (90.0%) patients of which only 6 landed up in the operating room. These findings are comparable with the study conducted by Yadav HK et al. who reported that intestinal obstruction was diagnosed by the presence of multiple air-fluid levels in the abdomen and when present due to intussusception was difficult to reduce hydrostatically.¹¹ These findings were also similar to the observations made by Khorana et al.¹² Blood investigations, such as TLC, CRP, lactate levels observed in babies who underwent surgical intervention for unsuccessful attempts of reduction were observed to be higher than that in cases who had successful hydrostatic reduction as mentioned in our result section. The results were in accordance with the study conducted by Lee DH et al.¹³ Our study, in addition found that hypokalemia was associated with failure of nonoperative management.

In the present study, 61.8% of patients had a reduction of intussusception in the first attempt, 20.9% of patients required two attempts, and 2.7% of patients had to undergo three attempts. The overall success rate for hydrostatic reduction was 85.5%. The results are consistent with the study conducted by Fakhry T et al. which determined that the overall success rate of reduction was 85% in his study.¹⁴ Similarly, Kobborg M et al. found that 48% had non-surgical reduction as the primary treatment, and among them, successful results were observed among 32% of the patients.¹⁵

We acknowledge that our study has limitations. Firstly, all patients underwent hydrostatic reduction, so a comparison with pneumatic reduction could not be studied. Furthermore, ultrasound is subjective and a single radiologist could not evaluate all cases, possibly reducing our sensitivity and accuracy. Further studies addressing these concerns is strongly encouraged.

CONCLUSION

Hydrostatic reduction of intussusception is a safe and effective method of management of intussusception whenever indicated. Surgical intervention is required in case of complicated intussusception. Factors reducing the likelihood of nonoperative reduction of intussusception include continuous pain, irritability, tenderness, deranged biochemical parameters, such as TLC, CRP levels, lactate levels, potassium levels. Patients with air fluid levels on X-ray were more likely to end up in surgery. Ultrasound findings of bowel wall edema, aperistaltic gut loops, and a pathological lead point were also associated with failure of hydrostatic reduction.

ORCID

Jibreel Y Shah  <https://orcid.org/0009-0005-9260-338X>
 Imad Banday  <https://orcid.org/0000-0003-2522-0600>
 Hanna Z Hamdani  <https://orcid.org/0000-0002-6435-6554>
 Mohd Fazlul Haq  <https://orcid.org/0000-0001-8732-0362>
 Fazl Q Parray  <https://orcid.org/0000-0003-3657-7808>
 Meeran Banday  <https://orcid.org/0009-0005-5020-6212>

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