

Original Article

Efficacy of fluoroscopy-guided hydrostatic reduction of acute ileocolic intussusception in children-one center experience

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ABSTRACT

Background: Intussusception is one of the common causes of acute abdomen in children with male preponderance. Most of the cases are idiopathic in origin. Abdominal ultrasound is the modality of choice to diagnose this condition. Reduction either by hydrostatic or pneumatic technique, is the first modality of the therapeutic approach, while failed cases necessitate surgical intervention.

Methods: In this retrospective study, 31 patients underwent fluoroscopy-guided hydrostatic reduction of ileocolic intussusception, between May 2017 to January 2023. The data of all patients, consisting of age, sex, and presenting complaint, were retrieved from the hospital's electronic database record. At presentation, all patients were adequately resuscitated, and all basic investigations were achieved. The preliminary diagnosis of intussusception, based on history and examination, was confirmed by abdominal ultrasound, in all patients. The hydrostatic reduction was attempted in all cases lacking signs and symptoms of peritonitis and shock, irrespective of the duration of symptoms. Patients with successful reduction were observed overnight and discharged the next day. Surgical intervention was performed in failed/incomplete reduction cases.

Results: Among 31 children (up to 5 years of age), 23 (74.20%) were male and 8 (25.80%) were female (male to female ratio: 2.8:1). In our study 58.06% cases presented within the first 24 hours of onset of symptoms, followed by 32.25% and 9.68% between 24-48 hours and 48-96 hours respectively. A high success rate (83.33%) was observed in patients who presented within 24 hours, followed by patients who presented between 24-48 hours (50%) and 48-96 hours (33.33%). Overall, hydrostatic reduction was successful in 67.74% of cases. Ten patients (32.26%) needed surgical intervention.

Conclusion: Fluoroscopy-guided hydrostatic reduction of intussusception is an effective therapeutic modality that avoids surgery and anesthesia-related risks. Early presenting patients showed a high success rate which signifies the importance of quick diagnosis. We suggest that if there is no contraindication, all cases, regardless of duration, should be attempted for hydrostatic reduction as late-presenting patients can also benefit from this modality.

Keywords: Children, Intussusception, Fluoroscopy, Hydrostatic reduction

INTRODUCTION

Intussusception is a common cause of acute abdomen in the pediatric age group, with nearly 66% of cases occurring in children below one year, the majority between 5-9 months. [1-3] The incidence is reported as 1-4/2000 [4-9], with a 2-3:1 male-to-female ratio. [1] Most cases (95%) are considered idiopathic, predominantly in the ileocolic region. [4] Predisposing factors include hyperplasia of Peyer's patches,

respiratory or intestinal tract infections, appendicitis, thick inspissated stool, and gut dysmotility postoperatively. [10,11]

Identifiable pathological lead points are present in 2-12% of cases, including Meckel's diverticulum (32.4%), duplication cysts (12.5%), aberrant tissue (8.5%), polyps (8.5%), lymphoma (5.7%), and Henoch-Schoenlein purpura (3.4%). [10] Patients commonly present with sudden colicky abdominal pain, vomiting, and bloody

stool, with a characteristic "currant jelly" appearance indicating prolonged duration. [11, 12] Abdominal distension and fever may develop after 24 hours. [13] Clinical examination may reveal a sausage-shaped mass and the "Dance sign" in the right lower quadrant. [10] The classic triad of abdominal pain, bloody stool, and palpable abdominal mass is present in less than 50% of cases. [8]

Abdominal radiograph has limited diagnostic value but can reveal signs of intussusception, intestinal obstruction, or pneumoperitoneum. [4,10] Abdominal ultrasound is the preferred modality, with a 98% sensitivity and specificity, showing characteristic signs like the target sign on the transverse plane and various signs on the longitudinal section. [4,5,8,10] CT scans, though not the first line due to radiation exposure, can be used in complicated cases. [8]

Untreated intussusception can lead to severe complications, including bowel ischemia, necrosis, perforation, peritonitis, shock, and death. [1] Non-surgical reduction, either pneumatic or hydrostatic under imaging surveillance, is the initial treatment option. [6,12].

The purpose of the present study is to evaluate our experience regarding the effectiveness of fluoroscopy-guided hydrostatic reduction of acute ileocolic intussusception in children.

METHODS

This retrospective study was carried out at the Maternity and Children's Hospital in Dammam, Saudi Arabia, from May 2017 to January 2023. The approval of the study protocol was obtained by the Institutional Review Board.

The study consisted of 31 patients who were diagnosed sonographically with ileocolic intussusception. Patients up to 14 years of age, were included in the study, while hemodynamically unstable patients, having signs of peritonitis, evidence of pneumoperitoneum on abdominal radiograph, ileo-ileal intussusception and intussusception with lead point diagnosed on ultrasound, were excluded from the study.

On arrival at the Emergency Department, a detailed history was taken from parents/guardians, followed by a physical examination. An intravascular line was achieved to commence I/V fluid and I/V antibiotics (metronidazole and cefuroxime). A nasogastric tube was passed in all cases. Baseline investigations including CBC, serum electrolytes, renal function tests, liver function tests, blood grouping, and cross-matching, were obtained. Once adequate hydration level was achieved, patients were transferred to the radiology department with a preliminary diagnosis of intussusception, based on history and physical examination. An erect abdominal radiograph (to exclude pneumoperitoneum) and abdominal ultrasound were done in all cases. Once

an ileocolic intussusception was established by ultrasound, parents were explained about the diagnosis, procedure of reduction, and its pros and cons; informed written consent was obtained for the procedure and possible surgery. At the same time, operation theater staff was kept on stand-by for possible emergency surgery, in case of bowel perforation during the reduction process or unsuccessful reduction. The patients were shifted to the fluoroscopy room where preparations were made for fluoroscopy-guided hydrostatic reduction using omnipaque contrast material.

The patients were laid in a supine position and a xylocaine-lubricated appropriate-size Foley catheter was inserted into the rectum and the balloon was inflated with 15-30 ml of saline water according to the age of the patient. The buttocks were taped together to prevent leakage of the contrast so that sufficient intraluminal pressure was developed. We did not use sedation for reduction, instead, we allowed one of the parents/guardians to stay with the patient during the procedure to minimize the anxiety and stress of the patient. The contrast enema bag containing one liter of omnipaque contrast was positioned initially at a height of 90 cm (3 feet) above the buttock level of the patients. We decreased and increased (maximum 120 cm) the height, accordingly, depending upon the age of the patient and the ease or difficulty in reduction of the mass. The enema bag tube was connected with the Foley's catheter and a free flow of contrast was established under gravity effect and the progression was monitored retrogradely under fluoroscopy surveillance. The reduction was deemed successful when the free flow of contrast was seen in the terminal ileum (Fig. 1).

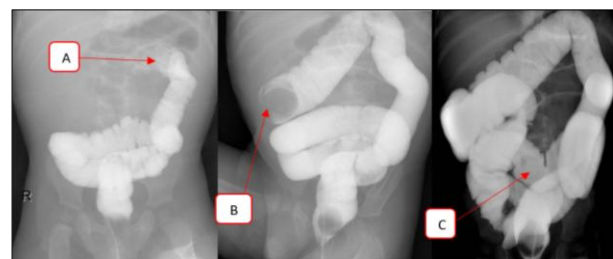


Figure 1: Fluoroscopic images of hydrostatic complete reduction. A) Ileo-colic intussusception. B) Reduction in progress. C) Complete reduction, indicated by efflux of contrast in distal ileum.

The duration of the attempt of reduction lasted a maximum of 3 minutes. In case of failure of the first attempt, two more attempts were made with an interval of 3 minutes between each attempt. During the procedure, the patients were observed closely for vital signs and general condition. After successful reduction, the contrast liquid was maximally evacuated from the bowl and Foley's catheter was removed after deflating the balloon. The patients were admitted to the pediatric surgery ward to observe for any complications. The

patients were discharged the next day when they had no abdominal symptoms, tolerated oral feed, and passed normal bowel motion.

In a few cases where contrast was traced up to caecum, but no efflux was observed in the small intestine, a follow-up abdominal ultrasound was repeated to confirm reduction. In cases of failed reduction (Fig. 2), after three attempts, all the cases were subjected to operative manual reduction. The medical record of all patients was collected retrospectively from the hospital database record. For each patient, age, gender, presenting symptoms, duration of symptoms, and the outcome of hydrostatic reduction, were recorded.

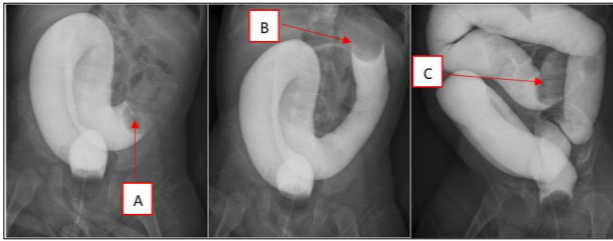


Figure 2: Fluoroscopic images of hydrostatic incomplete reduction. A) Ileo-colic intussusception. B) Reduction in progress. C) Incomplete reduction indicated by no efflux of contrast in distal ileum.

RESULTS

A total of 35 cases of ileocolic intussusception were admitted during the study period between May 2017 to January 2023. Out of 35 patients, 4 patients were not included in the study due to contraindications for hydrostatic reduction, as they already had signs and symptoms of peritonitis and abdominal distension, at presentation and these patients underwent prompt surgery. A total of 31 patients met the inclusion criteria of hydrostatic reduction. The age ranged from 4 months (the youngest patient) to 5 years (the eldest patient) of age with a mean age of 23 months. Out of 31 patients, 23 (74.20%) were male and 8 (25.80%) were female providing a male-to-female ratio of 2.8:1 (Table 1). Relatively, more cases (38.70%) occurred in children between two to three years of age, but the majority of cases (83.87%) were presented within the first three years of age (Table 1).

The presenting symptoms, in descending order of occurrence, included abdominal pain / irritability / excessive crying (100%), vomiting (83.87%), a history of passage of currant jelly stool or findings on per rectum examination (45.16%), palpable abdominal mass (32.26%), and fever (12.90%) (Table 1). Two patients (6.45%) exhibited a pathological lead point, with one having a small cystic gut duplication and the other having Meckel's diverticulum.

Nine patients (29.03%) presented within 12 hours of symptom onset, 9 patients (29.03%) between 12-24

hours, 10 patients (32.26%) between 24-48 hours, and 3 patients (9.68%) after 48 hours. The majority (88.89%) of successful hydrostatic reductions occurred in patients presenting within 12 hours of symptom onset, followed by those presenting between 12-24 hours (77.78%), between 24-48 hours (50%), and after 48 hours (33.33%) (Table 2).

Table 1: Different Parameters

Parameters		Number of patients	Percentage
Age (Years)	>1	10	32.26
	1-2	4	12.90
	2-3	12	38.70
	3-4	4	12.90
	4-5	1	3.22
	Total	31	100
Sex	Male	23	74.20
	Female	8	25.80
	Total	31	100
Clinical Presentation and findings	Abdominal pain/irritability /excessive crying	31	100
	Vomiting	26	83.87
	Currant jelly stool	14	45.16
	Palpable abdominal mass	10	32.26
	Fever	4	12.90
	Pathological lead point	2	6.45

In 21 patients (67.74%), intussusception was successfully reduced while in 10 patients (32.26%) it was unsuccessful (Table 3). Failed or incomplete hydrostatic reduction cases (32.26%) underwent prompt surgery. At surgery, no intussusception was found in 3 patients (spontaneous reduction), and in 4 patients it was reduced easily. In 3 patients operative manual reduction failed and out of these 3 patients one patient had small cystic gut duplication, one patient had Meckel's diverticulum and in one patient the gut was found gangrenous which necessitated gut resection and end-to-end anastomosis (Table 3).

Table 2: Symptoms Duration

Duration	No. of cases	Hydrostatic reduction
<24	18 (58.06%)	15 (83.33%)
24-48	10 (32.25%)	5 (50%)
48-96	3 (9.68%)	1 (33.33%)
Total	31	21 (67.74%)

In 10 patients (47.62%), the intussusception was successfully reduced at the first attempt, in another 10 patients (47.62%) at the second attempt, and in one patient (4.76%) at the third attempt (Table 4). Our study reported no instances of bowel perforation during the reduction procedure, and we did not observe any complications or recurrent intussusception after

reduction. Importantly, there was no mortality in our study.

Table 3: Outcome of hydrostatic reduction

Outcome	No. of cases	Percentage
Hydrostatic Reduction	21	67.74
Surgery (Hydrostatic reduction failed)	10	32.26
Total	31	100
At Surgery		
No Intussusception found	3/10	30
Intussusception reduced easily	4/10	40
Gut Resection	3/10	30
Total	10	100

Table 4: Number of Attempts

No. of attempts	Cases	Percentage
First	10	47.62
Second	10	47.62
Third	1	4.76
Total	21	100

DISCUSSION

Ileocolic intussusception is an infolding of the terminal ileum into the adjacent ascending colon through the ileocecal valve. Later, it may progress distally, till it may protrude through the anus. The first description of intussusception was made by Barbette in 1692 and the first attempt to achieve hydrostatic reduction of intussusception was made by Herald Hirschsprung in 1876 [4], but it took too long till 1977, when the characteristic findings of intussusception on ultrasound, were defined. [2,4]

Hydrostatic reduction of intussusception, under fluoroscopy control, became the first method of reduction. Initially, barium was used as contrast material, which nowadays is rarely used, because of the risk of peritonitis, if bowel perforation occurs during the reduction process. Instead, water-soluble contrast mediums such as cystografin or gastrografen, are in practice nowadays. [5] Although hydrostatic reduction under ultrasound surveillance is becoming a more popular modality for reduction, still many radiologists prefer fluoroscopy-guided pneumatic or hydrostatic reduction. [5] The main drawback of ultrasound is the need for expertise availability, as ultrasound results are exclusively operator-dependent, whereas fluoroscopy provides direct monitoring and visual assessment of the process of reduction, and the results can easily be interpreted even by junior doctors. Overall, there is no significant difference in reduction rate between these modalities, The choice of modality depends upon the facility, feasibility, and expertise available in the organization. [14] We used fluoroscopy-guided reduction modality, using omnipaque contrast material.

In our study, we found male dominance (M: F = 2.8:1), and this observation has been constantly noticed in the literature. [11,14,15,16,17] We have observed that the

majority of cases (83.87%) occurred within the first 3 years of age, mostly (38.70%) being between 2-3 years of age (Table 1). This finding is not consistent with many other studies, mentioning that most cases fall between 4-10 months [1], between 4-12 months [3], and between 5-9 months. [15]

The most prominent symptom was abdominal pain which is inconsistent with other studies [1,4] and if irritability or excessive crying in younger patients is also considered a sign of pain, then all patients had abdominal pain at presentation, which is comparable with one other study. [11] Vomiting was the second most common (83.87%) feature in our study but, in some other studies vomiting as the first most common presenting symptom, has been observed. [9,14,17] The incidence of the classic triad of symptoms, consisting of abdominal pain, vomiting, and bleeding per rectum (on history or per rectal examination), was noticed in 45.16% of cases, that follow the trends in literature.[16]

In our study, the majority of cases (58%) presented within less than 24 hours of symptom onset (Table 2), aligning with findings from a Swiss study where 52% of patients presented within 24 hours. [3] In contrast, some other studies reported lower proportions, with 25% [3] and 15% [15] presenting within 24 hours of symptom onset. Additionally, 32.25% and 9.68% of patients presented between 24-48 hours and 48-96 hours, respectively, in our study (Table 2). Another study mentioned that 40% and 45% of cases presented between 24-48 hours and after 48 hours, respectively. [15]

The success rate of hydrostatic reduction was highest (88.89%) in patients presenting within the first 12 hours of symptom onset, with a subsequent decline in success rate observed over time (Table 2). This decline can be attributed to the progressive edema of the invaginated intestine due to lymphatic, venous, and arterial blood flow obstruction with time, reducing the likelihood of successful reduction. A similar trend was noted in another study, where a duration exceeding 12 hours was identified as a crucial factor for unsuccessful enema reduction. [7]

When evaluated within a 24-hour timeframe, the successful reduction rate was 83.33% for patients presenting in the first 24 hours of symptom onset (Table 2). This finding aligns with other research reporting a 93% success rate in groups with symptoms within 24 hours. [12] However, the literature also presents lower success rates of 25% and 52% for patients presenting within 24 hours. [3] Duration exceeding 24 hours was associated with a lower success rate, consistent with observations from other studies. [7,12,15] In our study, the success rate dropped from 83.33% (15/18) to 46.15% (6/13) after 24 hours, highlighting a substantial link between the onset time of symptoms and the time

for attempted reduction. Therefore, a duration exceeding 24 hours may be considered a predictor of relatively unsuccessful reduction. This observation contrasts with Raymond ZML's findings [1] and Wong et al.'s observations [17], where no significant association between the time of symptom onset and reduction rate was found. On the contrary, many studies, including ours, have identified a significant rise in the failure rate with an increasing duration of symptoms. [7,12,15,16]

CONCLUSION

Intussusception is a leading cause of acute abdomen in young children, primarily occurring within the first three years of age. Hydrostatic reduction of ileo-colic intussusception under fluoroscopic control is a simple and effective management approach. Early diagnosis is crucial for a high success rate in hydrostatic reduction and to avoid surgery. Therefore, a high index of suspicion for intussusception is recommended in patients under 5 years of age presenting with acute abdomen. While the success rate may decrease in late-

presenting cases, hydrostatic reduction can still be effective. It is suggested that all cases of ileo-colic intussusception, regardless of duration (in the absence of peritonitis and shock symptoms), should undergo hydrostatic reduction as the primary treatment. This approach reduces the risk of surgery and anesthesia, shortens hospital stays, and alleviates socioeconomic strain on both the family and the hospital.

Conflict of Interest: Nil

Source of Support: Nil

Consent to Publication: Author(s) declared taking informed written consent for the publication of clinical photographs /material (if any used), from the legal guardian of the patient with an understanding that every effort will be made to conceal the identity of the patient, however it cannot be guaranteed.

Authors Contribution: Author(s) declared to fulfill authorship criteria as devised by ICMJE and approved the final version. Authorship declaration form, submitted by the author(s), is available with the editorial office.

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