Iran J Pediatr. 2018 February; 28(1):e62442. doi: 10.5812/ijp.62442.

Published online 2018 February 19. **Research Article**

Ultrasound Guided Reduction of Intussusception with Saline and Evaluating the Factors Affecting the Success of the Procedure

Veli Avci,[1,*] Kemal Agengin,[1] and Salim Bilici[2]

[1]Van Yuzuncuyil University, Faculty of Medicine, Pediatric Surgery Department, Van, Turkey
[2]Health Sciences University Diyarbakir, Gazi Yasargil Training and Research Hospital, Clinic of Pediatric Surgery, Diyarbakır, Turkey

[*]*Corresponding author*: Dr. Veli Avci, Suvaroglu Street, Umar Aparts No. 3-23, 65100 Ipekyoli, Van, Turkey. Tel: +90-5055391710, E-mail: veliavci_21@hotmail.com

Received 2017 October 04; **Revised** 2017 December 26; **Accepted** 2018 January 18.

Abstract

Background: Intussusception is a major cause of acute abdomen in childhood. Prompt diagnosis and appropriate treatment of intussusception is of prime importance for preventing morbidity and mortality. In this study, we aimed to investigate the effectivity of ultrasound (USG)-guided hydrostatic reduction of intussusception with saline and to investigate the factors affecting the success of this method.

Methods: A total of 100 children with intussusception who were treated by hydrostatic reduction with saline were retrospectively reviewed. The effect of age, gender, duration of symptoms, rectal bleeding, number of reduction attempts performed, and the diameter and length of the invaginated segment measured on USG were evaluated.

Results: Successful reduction was achieved in 88 (88%) patients. Mean age was 24.83 months, with 25.59 months in patients with successful reduction and 20 months in patients with failed reduction. Reduction was successful in 83.9% of the patients with a history of rectal bleeding and in 94.7% of the patients with no history of rectal bleeding ($P > 0.05$). Mean duration of symptoms was 2.74 days in the patients with successful reduction and 4.33 days in the patients with failed reduction. The mean diameter and length of the invaginated segments measured on USG were 3.5 cm and 5.12 cm in the patients with successful reduction and 4.27 cm and 9.23 cm in the patients with failed reduction, respectively. No significant difference was observed between the patients with successful and failed reduction in terms of rectal bleeding, vomiting, gender, age, and body weight ($P > 0.05$). It was also found that success rate increased as the number of reduction attempts increased and the success rate decreased as the duration of symptoms and the diameter and the length of the invaginated segment increased ($P < 0.05$).

Conclusions: In conclusion, USG-guided reduction of intussusception with saline is a practical and safe method that yields high success rates. Repeating this method in patients with partial reduction that are clinically stable leads to a significant increase in the success of the procedure. A prolonged duration of symptoms and an increase in the size and the diameter of the invaginated segment may have adverse effects on the success of the procedure.

Keywords: Hydrostatic Reduction, Saline, Intussusception

1. Background

Intussusception is the most common cause of bowel obstruction in children aged between 3 - 24 months (1, 2). The hallmark presenting symptoms of intussusception include vomiting and abdominal pain and the most common clinical findings include rectal bleeding and a palpable mass in the right side of the abdomen (3). The diagnosis of intussusception is often established based on the physical signs-symptoms and the radiological images. Ultrasonography (USG) is the method of choice and often provides a sensitivity and specificity approaching 100% in the hands of an experienced radiologist (3). Although intussusception was previously treated by surgical methods, today it is mostly treated by pneumatic or hydrostatic enema reduction under fluoroscopy or USG guidance.

In this study, we aimed to evaluate the effectivity of USG-guided reduction of intussusception with saline and to investigate the factors affecting the effectivity of this method.

2. Methods

The retrospective study included 100 children who underwent reduction of intussusception with saline in our pediatric surgery department between 2010 and 2012. Age, gender, duration of symptoms, rectal bleeding, diameter and length of the invaginated segment measured on USG, and the total amount of saline administered, based on

body weight were recorded for each patient. Success rate was also noted for each patient.

Definitive diagnosis was established by USG. Prior to the procedure, vascular access was established and fluid administration was achieved. Following the monitoring process, the patients were provided with home comfort. First, a cushion was placed under the head. Second, some of the mothers sang songs or lullabies and some others played music on their cell phones for their children. Moreover, a pacifier was given to the patients that sucked it.

The procedure was initiated by inserting a Foley catheter into the rectum. The foley catheter was choosen according to the body size of the children. 10 fr for children under 1 year, 14 fr for 1 - 2 years, and 16 - 18 fr for children which were older than 3 years, were used. The catheter was inflated 4 - 5 times its normal size (20 - 25 cc) and then retracted to the entrance of the anal canal to prevent fluid leakage. Prewarmed saline (36.5 - 37.5°C) was placed 90 - 150 cm higher than the patient (90 - 150 cm H_2O pressure) and introduced into the rectum and the proximal part of the colon. The patient was closely monitored throughout the procedure. Following the introduction of the saline, the abdominal pain initially deteriorated but was subsequently relieved completely and even the patient fell asleep often .The diameter of the invaginated segment was explored on USG.

The cases that could not be reduced or had a partial reduction underwent a second reduction after 2 - 3 hours. Open surgery was performed in the patients with no reduction in the invaginated segment. The patients with successful reduction were monitored for 24 hours after the procedure. Prior to hospital discharge, all the patients underwent USG to check for recurrent intussusception. The patients with no pathologies were discharged uneventfully.

2.1. Statistical Analysis

For continuous variables, the success rates of the reduction procedure were analyzed using one-way ANOVA. The relationships between categorical variables were analyzed using the chi-square test.

3. Results

The 100 patients included 58 (58%) boys and 42 (42%) girls (Table 1). Reduction was successful in 88% of the patients, with 86.2% in boys and 91.5% in girls. Mean age was 24.83 months, with 25.59 months in patients with successful reduction and 20 months in patients with failed reduction. Reduction was successful in 83.6% of the patients with a history of vomiting and in all the 15 patients with no history of vomiting. Reduction was successful in 52 out of 62 (83.9%) patients with a history of rectal bleeding and in 36 out of 38 (94.7%) patients with no history of rectal bleeding. Mean duration of symptoms was 2.74 days in the patients with successful reduction and 4.33 days in the patients with failed reduction. Mean body weight was 11.49 kg in the patients with successful reduction and 10.67 kg in the patients with failed reduction.

The mean diameter and length of the invaginated segments measured on USG were 3.5 cm and 5.12 cm in the patients with successful reduction and 4.27 cm and 9.23 cm in the patients with failed reduction, respectively. Aproximately 78 cc/kg saline was administered for every single patient in each time.

According to our study; no significant difference was observed between the patients with successful and failed reduction in terms of rectal bleeding, vomiting, gender, age, and body weight ($P > 0.05$). But it was also found that success rate increased as the number of reduction attempts increased and the success rate decreased as the duration of symptoms, the diameter and the length of the invaginated segment increased ($P < 0.05$).

4. Discussion

Intussusception is a leading cause of acute abdomen in childhood. It has been reported to have an incidence of 1 - 4 in 2,000 infants and it is most commonly seen in children aged between 3 months and 3 years (3). A delay in the diagnosis and treatment of intussusception may lead to bowel necrosis and perforations, thereby resulting in death.

A number of surgical and conservative approaches have been used in the treatment of intussusception. Today, conservative approach remains the method of choice, which includes reduction with fluid (hydrostatic) or air (pneumatic) enema under USG or fluoroscopic guidance. The cases that cannot be reduced with hydrostatic and pneumatic enema and present with diffuse peritonitis, perforation, and deep shock are often reduced by open surgery.

Barium enema was the mainstay method among the conservative approaches and has been used for a long time. However, it was superseded by pneumatic and hydrostatic reduction since it is likely to cause dramatic outcomes such as peritonitis and even death in the presence of perforation. Pneumatic reduction is performed with fluoroscopy guidance at 80 - 120 mmHg pressure. The major disadvantage of this approach is the risk of tension pneumo peritoneum in the presence of perforation. Moreover, since the whole procedure is performed under fluoroscopic guidance, both the relatives of the patients and the health staff are exposed to ionizing radiation. Kim et al. described a USG-guided hydrostatic reduction model in 1982,

Table 1. Demographic Characteristics of Patients

	All	Successful	Unsuccessful	P Value
	100	88	12	< 0,05
Age, mo	24,83	25,49	20	> 0,05
				0,460
Gender (Male/Female), %	58/42	86,2/90.5	13,8/9,5	> 0,05
				0,544
Vomiting Symptom (+/-)	85/15	73 (85,9)/15 (100)	12 (14,1)/0 (0)	> 0,05
				0,134
Bleeding Gaita (+/-)	62/38	52 (83,9)/36 (94,7)	10 (16,1)/2 (5,3)	> 0,05
				0,099
Duraiton of symptoms	2,93	2,74	4,33	< 0,05
				0,032
Weight, kg	11,39	11,49	10,67	> 0,05
				0,565
Diameter of invaginated segment, cm	3,6	3,5	4,27	< 0,05
				(0,006)
Lenght of the invaginated Segment, cm	5,61	5,12	9,23	< 0,05
				(0,008)

in which they proposed that saline should be administered through a foley catheter inserted in the rectum with the saline container elevated to a height of 90 - 150 cm. The authors also suggested that reduction is performed through the compression of the invaginated segment by saline under USG guidance (4).

The roles of saline and air enema in the reduction of childhood intussusception have been compared in numerous studies (5-12). Although both methods have been shown to be superior to one another, both of them are widely used in clinical practice (6-11). Sadigh et al. conducted a meta-analysis that reviewed 32,451 children and reported that pneumatic enema yielded a success rate of 82.7% in 16,187 children and saline yielded a success rate of 69.6% in 13,081 children. The study also reported that the success rate of pneumatic enema was significantly higher than that of hydrostatic enema (10). On the other hand, Bai et al. (13). reported a high success rate of 95.5% in their large-scale study with 5,218 patients and Krishnakuma et al. reported a high success rate of 96% (14). In our study, the success rate was 88% and it was also observed that our unsuccessful cases belonged to the times we used to apply this method at beginning. No perforation or mortality occurred in any of our patients. Although both approaches yielded high success rates in medical world, reduction with saline remains the mainstay approach in our clinic since it leads to lower exposure to ionizing radiation and in addition, although this approach requires higher dependency on radiologists, this disadvantage has been eliminated by the USG experience gained by the pediatric surgeons.

A number of factors have been shown to affect the success of reduction with enema (Table 2) (15-20). These factors include age, gender, history of vomiting, rectal bleeding, and abdominal pain, mesenteric lymphadenopathy, length of the invaginated segment measured on USG, presence of free abdominal fluid on USG, bowel wall thickness, duration of symptoms, sedation, lethargy, localization of the intussusception, severe dehydration, small bowel obstruction, rectal prolapse of the invaginated segment, air-fluid level on radiography, distension, diarrhea, constipation and also number of reduction attempts (Table 3). As seen in the although although there is no consensus among the studies regarding the role of these factors, the most common factors reported by these studies include rectal bleeding (n = 12), age (n = 10), and duration of symptoms (n = 10). Nevertheless, all of these studies and our study as well have indicated that both approaches have yielded similar success rates for both genders.

Literature shows that rectal bleeding decreases the success rate of reduction (18, 19, 23-29). Rectal bleeding is an indicator of edema and circulatory impairment and is seen

Table 3. Number of Reduction Attempts

Number of reductions	Total	Successful	Unsuccessful	Operated	P Value
1st Reduction	100	55	45	2	
2nd Reduction	43	21	22	6	
3rd Reduction	16	10	6	4	
4th Reduction	2	2	0	0	
All	100	88	12	12	< 0,05; 0,016

in 60% of the patients with intussusceptions (3). Rectal bleeding may occur both in the early and late stages of intussusception and is a highly disturbing issue for the relatives of the patients. In our study, rectal bleeding was present in 62% of the patients. Moreover, the success rate of reduction was relatively lower in the patients with rectal bleeding compared to those without rectal bleeding but no statistical difference was observed.

A prolonged duration of symptoms has been shown to decrease the success rate of reduction in all the previous studies excluding the study by Taren et al. (17). These authors reported that reduction was successful in 91% of the patients and the duration of symptoms had no effect on the success of the procedure. Similarly, Khorana et al. also reported that the success of the procedure was not affected within the first 48 h after the onset of symptoms but started to decrease beginning from the third day after the onset of the symptoms (25). When the duration of symptoms is prolonged, the compression of the mesenteric arteries in the invaginated segment leads to bowel ischemia and edema, thereby increasing the resistance and complicating the reduction process. In our study, although successful reduction was achieved in a 13-year-old male patient who presented to our clinic on the 10th day after the onset of the symptoms, a prolonged duration of symptoms was found to have adverse effects on the success of the procedure. Moreover, we also found that the mean duration of symptoms was 2.74 days in the patients with successful reduction and 4.33 days in the patients with failed reduction, which supports the finding reported by Khorana that postulated that the success rate of reduction starts to decrease beginning from the third day after the onset of the symptoms.

Intussusception has been shown to occur in 75% of the cases aged below 2 years and in 90% of the cases aged below 3 years. The pathologic lead point has been reported to increase with age, from 5% in children below the age of 1 year to 60% in children aged between 5 - 14 years (3). Although previous studies have indicated that age can be an effective factor for the success of the procedure, the hypotheses proposed by these studies remain controversial. Karadağ et al, Fallon et al, Khorana et al and Nayak et al. suggested that age is an effective factor for the success of the procedure, whereas our study and 5 other studies found that age has no effect on the success of the procedure (15, 19, 23, 25). Fallon also postulated that the success rate in patients aged below 1 year is relatively lower since these children may be reluctant to undertake the aggressive intervention performed by the radiologist (19). On the other hand, Khorana suggested that body weight, rather than age, could be used as a predictive factor in older patients since the lead point is higher in these patients (25). In our study, the success rate was relatively lower in the children with a body weight of < 12 kg, which could be attributed to the lower bowel size of these patients.

The relationship between the length of the invaginated segment measured on USG and the success of the procedure has been investigated only by He et al. and Ozcan et al. He et al. reported that the success rate was lower in the patients with a length of > 7 cm, whereas Ozcan et al found no relationship between the length of the invaginated segment and the success of the procedure (21, 26). In our study, we found that a 1-cm increase in the length of the invaginated segment decreased the success rate by 2.36 times and the correlation between the length of the segment and the failure of the procedure was statistically significant. Moreover, the length of the longest successfully reduced segment was 17 cm and the mean diameter of the segments was 3.5 cm. A 1-cm increase in the diameter of the segment statistically decreased the success rate by 3.47 times. Although bowel wall thickness has been investigated by previous studies (30), to our knowledge, there has been no study in the literature reporting on the diameter of the segment.

Successful reduction was achieved in 55 (55%) of our patients in the first attempt. The procedure was repeated in the patients in whom it could not be completely reduced and had limited reduction in the last attempt. In these patients, successful reduction was achieved in the second attempt in 21 (21%), in the third attempt in 10 (10%), and in the fourth attempt in 2 (2%) patients. In a similar study, Pazo et al. evaluated 21 patients with intussusception and re-

ported that successful reduction was achieved in the second attempt in 9 (43%) and in the third attempt in 4 (19%) patients (31). Conversely, Naidch et al. reported that successful reduction was achieved in the second attempt in only 2 (13.6%) out of 17 patients (22). In addition, Fallon et al. Flaum et al. and Briton et al. suggested that the success rates increased as the number of attempts increased (19, 30).

History of vomiting is a cardinal symptom of intussusception and was seen in 85% of our patients. Although Fallon et al. Khorana et al. and He et al. reported that the history of vomiting led to lower success rates, no significant correlation was found in our study between the history of vomiting and the success of the procedure (19, 25, 26).

4.1. Conclusions

USG-guided reduction of intussusception with saline is a practical and safe method that yields high success rates. Repeating this method in patients with partial reduction that are clinically stable leads to a significant increase in the success of the procedure. A prolonged duration of symptoms and an increase in the size and the diameter of the invaginated segment may have adverse effects on the success of the procedure.

References

1. Beasley SW, Hutson JM, Auldist AW. *Essential paediatric surgery*. Arnold; 1996.
2. Hamby LG, Fowler CL, Pokony WJ. Intussusception. In: Donellan WL, editor. *Abdominal Surgery of Infancy and Childhood*. Luxembourg: Harwood Academic Publishers; 2001. p. 42/1–42/19.
3. Columbani PM, Scholz S. Intussusception. In: Coran AG, Adzick NS, Krummel TM, Laberge JM, Shamberger RC, Caldamone AA, editors. *Pediatric Surgery*. Philadelphia: Saunders; 2012. p. 1093–110.
4. Kim YG, Choi BI, Yeon KM, Kim JW. Diagnosis and treatment of childhood intussusception using rea-time ultrasonography and saline enema: preliminary report. *J Korean Soc Med Ultrasound*. 1982;**1**(1):66–70.
5. Beres AL, Baird R. An institutional analysis and systematic review with meta-analysis of pneumatic versus hydrostatic reduction for pediatric intussusception. *Surgery*. 2013;**154**(2):328–34. doi: 10.1016/j.surg.2013.04.036. [PubMed: 23889959].
6. Jenke AC, Klaassen-Mielke R, Zilbauer M, Heininger U, Trampisch H, Wirth S. Intussusception: incidence and treatment-insights from the nationwide German surveillance. *J Pediatr Gastroenterol Nutr*. 2011;**52**(4):446–51. doi: 10.1097/MPG.0b013e31820e1bec. [PubMed: 21415671].
7. Hadidi AT, El Shal N. Childhood intussusception: a comparative study of nonsurgical management. *J Pediatr Surg*. 1999;**34**(2):304–7. [PubMed: 10052810].
8. Sanchez TR, Doskocil B, Stein-Wexler R. Nonsurgical management of childhood intussusception: retrospective comparison between sonographic and fluoroscopic guidance. *J Ultrasound Med*. 2015;**34**(1):59–63. doi: 10.7863/ultra.34.1.59. [PubMed: 25542940].
9. Boglione MM. Childhood intussusception: a comparative study of nonsurgical management. *J Pediatr Surg*. 2000;**35**(5):809. [PubMed: 10813357].
10. Sadigh G, Zou KH, Razavi SA, Khan R, Applegate KE. Meta-analysis of Air Versus Liquid Enema for Intussusception Reduction in Children. *AJR Am J Roentgenol*. 2015;**205**(5):W542–9. doi: 10.2214/AJR.14.14060. [PubMed: 26496576].
11. Alehossein M, Babaheidarian P, Salamati P. Comparison of different modalities for reducing childhood intussusception. *Iran J Radiol*. 2011;**8**(2):83–7. [PubMed: 23329922].
12. Kaiser AD, Applegate KE, Ladd AP. Current success in the treatment of intussusception in children. *Surgery*. 2007;**142**(4):469–75. discussion 475-7. doi: 10.1016/j.surg.2007.07.015. [PubMed: 17950338].
13. Bai YZ, Qu RB, Wang GD, Zhang KR, Li Y, Huang Y, et al. Ultrasound-guided hydrostatic reduction of intussusceptions by saline enema: a review of 5218 cases in 17 years. *Am J Surg*. 2006;**192**(3):273–5. doi: 10.1016/j.amjsurg.2006.04.013. [PubMed: 16920416].
14. Hameed S.Krishnakumar; Umamaheshwari. Ultrasound guided hydrostatic reduction in the management of intussusception. *Indian J Pediatr*. 2006;**73**(3):217–20. [PubMed: 16567915].
15. Nayak D, Jagdish S. Ultrasound guided hydrostatic reduction of intussusception in children by saline enema: our experience. *Indian J Surg*. 2008;**70**(1):8–13. doi: 10.1007/s12262-008-0002-3. [PubMed: 23133008].
16. Ramachandran P, Gupta A, Vincent P, Sridharan S. Air enema for intussusception: is predicting the outcome important?. *Pediatr Surg Int*. 2008;**24**(3):311–3. doi: 10.1007/s00383-007-2101-9. [PubMed: 18097672].
17. Fike FB, Mortellaro VE, Holcomb G3, St Peter SD. Predictors of failed enema reduction in childhood intussusception. *J Pediatr Surg*. 2012;**47**(5):925–7. doi: 10.1016/j.jpedsurg.2012.01.047. [PubMed: 22595574].
18. Fallon SC, Lopez ME, Zhang W, Brandt ML, Wesson DE, Lee TC, et al. Risk factors for surgery in pediatric intussusception in the era of pneumatic reduction. *J Pediatr Surg*. 2013;**48**(5):1032–6. doi: 10.1016/j.jpedsurg.2013.02.021. [PubMed: 23701778].
19. Fragoso AC, Campos M, Tavares C, Costa-Pereira A, Estevao-Costa J. Pneumatic reduction of childhood intussusception. Is prediction of failure important?. *J Pediatr Surg*. 2007;**42**(9):1504–8. doi: 10.1016/j.jpedsurg.2007.04.013. [PubMed: 17848239].
20. Karadag CA, Abbasoglu L, Sever N, Kalyoncu MK, Yildiz A, Akin M, et al. Ultrasound-guided hydrostatic reduction of intussusception with saline: Safe and effective. *J Pediatr Surg*. 2015;**50**(9):1563–5. doi: 10.1016/j.jpedsurg.2015.03.046. [PubMed: 25863544].
21. Britton I, Wilkinson AG. Ultrasound features of intussusception predicting outcome of air enema. *Pediatr Radiol*. 1999;**29**(9):705–10. doi: 10.1007/s002470050679. [PubMed: 10460334].
22. Flaum V, Schneider A, Gomes Ferreira C, Philippe P, Sebastia Sancho C, Lacreuse I, et al. Twenty years' experience for reduction of ileocolic intussusceptions by saline enema under sonography control. *J Pediatr Surg*. 2016;**51**(1):179–82. doi: 10.1016/j.jpedsurg.2015.09.022. [PubMed: 26592955].
23. McDermott VG, Taylor T, Mackenzie S, Hendry GM. Pneumatic reduction of intussusception: clinical experience and factors affecting outcome. *Clin Radiol*. 1994;**49**(1):30–4. [PubMed: 8299329].
24. Khorana J, Singhavejsakul J, Ukarapol N, Laohapensang M, Siriwongmongkol J, Patumanond J. Prognostic indicators for failed nonsurgical reduction of intussusception. *Ther Clin Risk Manag*. 2016;**12**:1231–7. doi: 10.2147/TCRM.S109785. [PubMed: 27563245].
25. He N, Zhang S, Ye X, Zhu X, Zhao Z, Sui X. Risk factors associated with failed sonographically guided saline hydrostatic intussusception reduction in children. *J Ultrasound Med*. 2014;**33**(9):1669–75. doi: 10.7863/ultra.33.9.1669. [PubMed: 25154951].
26. Yalcin S, Ciftci AO, Karaagaoglu E, Tanyel FC, Senocak ME. Presenting clinical features and outcome in intussusception. *Indian J Pediatr*. 2009;**76**(4):401–5. doi: 10.1007/s12098-009-0129-7. [PubMed: 19412587].
27. Li JE, Yang LJ, Wang J, Sheng M, Guo WL. Predictors of successful air enema reduction of intussusception in infants younger than 4 months. *J Pediatr Gastroenterol Nutr*. 2014;**58**(6):786–8. doi: 10.1097/MPG.0000000000000327. [PubMed: 24509301].

28. Katz M, Phelan E, Carlin JB, Beasley SW. Gas enema for the reduction of intussusception: relationship between clinical signs and symptoms and outcome. *AJR Am J Roentgenol*. 1993;**160**(2):363–6. doi: 10.2214/ajr.160.2.8424351. [PubMed: 8424351].
29. Ozcan R, Huseynov M, Emre S, Tutuncu C, Ertem Vehid H, Dervisoglu S, et al. A review of intussusception cases involving failed pneumatic reduction and re-intussusception. *Ulus Travma Acil Cerrahi Derg*. 2016;**22**(3):259–64. doi: 10.5505/tjtes.2016.79851. [PubMed: 27598590].
30. Pazo A, Hill J, Losek JD. Delayed repeat enema in the management of intussusception. *Pediatr Emerg Care*. 2010;**26**(9):640–5. doi: 10.1097/PEC.0b013e3181ef0426. [PubMed: 20805784].
31. Naiditch JA, Rigsby C, Chin A. Delayed repeated enema and operative findings after unsuccessful primary enema for intussusception. *Eur J Pediatr Surg*. 2012;**22**(5):404–8. doi: 10.1055/s-0032-1315804. [PubMed: 22773354].

Table 2. The Effect of Some Parameters on the Succes of Enema

	Karadag (20)	Britton and Wilkinson (21)	Fallon (18)	Flaum (22)	Fike (17)	Tareen (17)	McDermott (23)	Khorana (24)	He et al. (25)	Ramachandran (16)	Yalcin (26)	Britton (21)	Nayak (15)	Fragoso (19)	Li (27)	Katz (28)	Our Study
Age	+	-	+	-	-		-	+	-				+	-			-
Weight			+	-				+						-			-
Gender		-		-	-			-	-					-			-
Duration of symptoms	+				+	-	+	+	+				+	+	+	+	+
Vomit	-			+	-			+	+								-
Rectal bleeding	+		+	-	+		+	+	+	-	+			-	+	+	-
Abdominal pain	-							-									
Lead point on USG		-	-														
Invaginated segment measured		-							+								+
Wall thickness			+									-					
Sedation				+													
Lethargy					+						+						
Severe dehydration																+	
Air fluid level on radyography											+						
Abdominal free fluid		+									+						
Abdominal distension								+									
Localization of the invagination			+	+			+	+	+						+		
Small bowel obstruction							+	+		+		+				+	
Diarrhea								-									
Constipation								-									
Palpable mass			-		-		-	-								+	
Temperature			-		-			+									
Number of reduction attempts			+	+								+					+
Fluid in peritoneum									+			+					
Rectal prolapse										+							
Neutrophilia														+			
Diameter of the invaginated segment																	+

Abbreviations: +, sensible; -, senseless.