

Predictive Factors for Failure of Air Enema Reduction in Childhood Intussusception

Panida Bubphachai, MD*

Achariya Tongsin, MD*

Warangkana Ratanaprakan, MD**

Rangsan Niramis, MD*

*Department of Surgery, Queen Sirikit National Institute of Child Health, Bangkok, Thailand

**Department of Radiology, Queen Sirikit National Institute of Child Health, Bangkok, Thailand

Abstract

Background: Intussusception is the most common cause of intestinal obstruction in children under two years of age. Nonoperative reduction using air enema (AE) is an established treatment of childhood intussusception with the success rate of 70% at our institute.

Objective: The aim of this study was to evaluate predictive factors for failure of AE reduction in childhood intussusception.

Materials and Methods: Medical records of patients with intussusceptions who were treated by AE reduction at Queen Sirikit National Institute of Child Health from January 2009 to December 2013 were reviewed. The study emphasized on the success and failure rates of AE reduction of intussusceptions including risk factors affecting outcomes of AE reduction. The statistical differences were analyzed by Chi-square test and relative risk (RR) with 95% confidence interval. A p-value less than 0.05 were considered statistically significant.

Results: Two hundred and sixty-eight patients (173 males and 95 females) with 284 episodes of intussusception were treated by AE reduction. Of the total 284 attempted AE reduction, 196 (69.0%) were successful, while 88 (31.0%) were unsuccessful. The significant risk factors for failure of AE reduction included body temperature over 37.8 °C ($p<0.001$, RR= 3.62), lethargy ($p=0.001$, RR=2.68), rectal bleeding ($p=0.003$, RR= 2.34), abdominal distension ($p=0.004$, RR= 2.23), dehydration ($p=0.03$, RR=2.30), palpable rectal mass ($p<0.001$, RR= 19.93), palpable abdominal mass ($p<0.001$, RR= 2.72), radiological findings of complete small bowel obstruction ($p<0.001$, RR= 2.70), visible soft tissue mass in the left side of abdomen from plain abdominal films ($p<0.001$, RR=6.92) and intussusception at sigmoid and rectum ($p<0.001$, RR=3.25). Complication rates were increased in patients with failed AE reduction ($p<0.001$, RR=25.55).

Conclusion: Clinical presentations and radiological findings could be used to predict failure of AE reduction in childhood intussusception. AE reduction should not be performed in the patients with palpable intussusceptions in rectum by rectal examination because failure rate was nearly 100% in the present study.

Keywords: Intussusception, air enema reduction, predictive factor, success rate, failure rate

INTRODUCTION

Intussusception is the most common intestinal obstruction in children under two years of age¹. Definitive treatments for intussusception include non-

operative and operative procedures. Regarding non-operative reduction, hydrostatic barium enema (BE) reduction was introduced in the United State of America in 1927 and was popularized by Ravitch and

Correspondence address: Rangsan Niramis, MD., Department of Surgery, Queen Sirikit National Institute of Child Health, 420/8 Rajathevi, Bangkok 10400, Thailand; Telephone/Fax: +66 2354 8095, E-mail: rniramis@hotmail.com

McCune² in 1948. Air insufflations technique for intussusception reduction was described by Fiorito³, a Spanish radiologist, in 1959. However, hydrostatic BE reduction remained more popular than the others for over 40 years. In 1986, a report of air insufflations was reintroduced by Guo et al.⁴ from the People's Republic of China with a high success rate of reduction. Since then, pneumatic or air enema (AE) reduction is now popular everywhere as an alternative method to BE reduction. Success rates of AE reduction were reported between 70% and 90%⁵⁻⁷. At our institute, AE reduction was begun to reduce intussusceptions in 1991 and the success rate is now approximately 70%⁸⁻⁹. Many factors may influence the failure of AE reduction, but data regarding failed AE reduction are scarce and conflicting. Therefore, the authors reviewed experience at a tertiary children's hospital with intussusception treated by AE reduction in a 4-year period. The aim of this study was to determine predictive factors for failure of AE reduction.

MATERIALS AND METHODS

A retrospective study was conducted, including all of the patients with intussusceptions who were treated by AE reduction between January 2009 and December 2012. The study was begun after approval of the research proposal by the Institutional Review Board (Document No. 57-019.1). Patients were categorized into two groups according to the results of AE reduction. Age, symptoms, duration of clinical presentations, and radiological findings were recorded.

AE reduction was performed by placement of a Foley catheter (No.18 F.) into rectum, balloon inflation and strapping tape between the catheter and the buttock. A 3-way connector was applied to the Foley catheter, a sphygmomanometer and a pumping rubber bag (Figure 1). The success or failure of reduction was under fluoroscopic guidance. The pressure for reduction was controlled between 80 and 120 mmHg. Failure of AE reduction was defined when there was absence of air flow into the terminal ileum on at least two attempts.

Data were analyzed using SPSS version 6 (SPSS Inc. Chicago, IL, USA). Correlations between categorical variables were evaluated by Chi-square test. A *p*-value of less than 0.05 was considered significant. The likelihood of failed AE reduction was calculated as

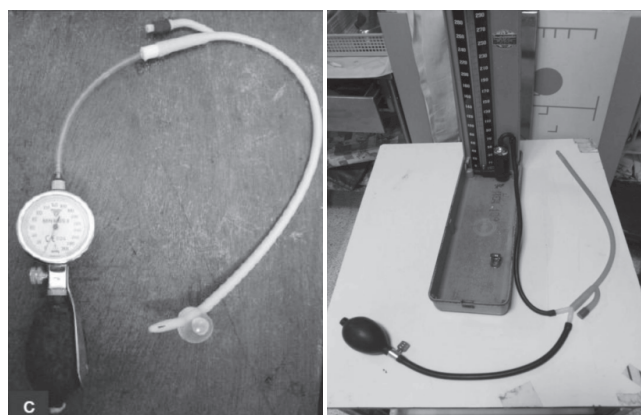


Figure 1 The apparatus used for air enema reduction at the Department of Radiology, Queen Sirikit National Institute of Child Health

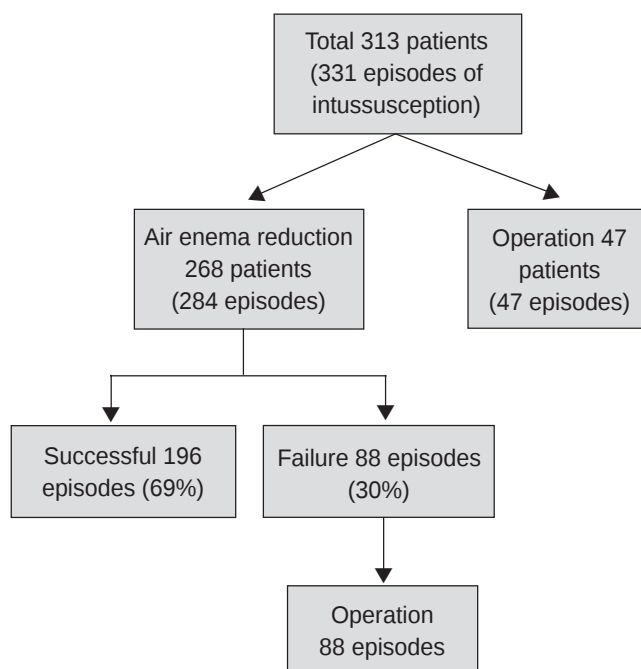


Figure 2 Guideline for management of 313 patients with intussusception

relative risk (RR) with 95% confidence interval (CI).

RESULTS

A total of 313 patients with 331 episodes of intussusception were treated during the study period. Forty-five patients with 47 episodes of intussusceptions were primarily treated by operative reduction. The remaining 268 patients (173 males and 95 females) with 284 episodes of intussusception were treated by AE reduction. Success and failure of AE reductions

Table 1 Demographic data of the 268 patients with 284 episodes of intussusceptions

Patient characteristics	AE reduction		<i>p</i> -value	Relative risk	95% confidence interval
	Success (%)	Failure (%)			
Gender					
Male (173)	115 (66.4)	58 (33.5)	0.076	0.637	0.370-1.089
Female (95)	73 (76.8)	22 (23.1)			
Age					
Over 2 years (14)	8 (57.1)	6 (42.8)	0.006	0.148	0.041-0.536
1-2 years (80)	72 (90.0)	8 (10.0)			
Over 2 years (14)	8 (57.1)	6 (42.8)	0.772	0.851	0.284-2.550
0-1 year (190)	116 (61.9)	76 (38.1)			
Duration of symptoms					
≤ 24 hours (169)	113 (66.8)	56 (33.17)	0.911	0.968	0.545-1.718
> 24 hours (115)	83 (72.1)	32 (27.8)			

Table 2 Clinical presentations of the 284 episodes in 268 patients with intussusception

Symptomatology	AE reduction		<i>p</i> -value	Relative risk	95% confidence interval
	Success (%)	Failure (%)			
Symptoms					
Lethargy	33 (51.5)	31 (48.4)	0.001*	2.686	1.511 - 4.777
Bloody stool	116 (63.1)	68 (36.9)	0.003*	2.345	1.321 - 4.164
Abdominal distension	37 (54.4)	31 (45.5)	0.004*	1.976	1.212 - 2.791
Vomiting	162 (67.2)	79 (32.9)	0.102	1.842	0.842 - 4.028
Abdominal pain	163 (70.5)	68 (29.4)	0.239	2.337	0.328 - 4.112
History of viral infection	39 (75)	13 (25)	0.325	0.698	0.352 - 1.385
Signs					
Fever	38 (48.1)	41 (51.8)	< 0.001*	3.627	2.096 - 6.277
Abdominal distension	92 (59.7)	62 (40.2)	< 0.001*	2.337	1.328 - 4.112
Dehydration	80 (59.7)	54 (40.2)	0.03*	2.303	1.376 - 3.857
Abdominal mass	112 (61.8)	69 (38.1)	< 0.001*	2.724	1.523 - 4.871
Rectal mass	2 (11.7)	15 (88.2)	< 0.001*	19.932	4.448 - 89.305
Bloody stool	114 (64.0)	64 (35.9)	0.019*	1.918	1.109 - 3.319

were noted in 196 (69%) and 88 episodes (31%), respectively (Figure 2). There was no significant difference of success or failure of AE reduction between male and female patients ($p=0.076$). Patients younger than one year or older than two years had higher failure rates than those with age at presentation between one and two years old (Table 1). Duration of symptoms less than 24 and over 24 hours was noted to have no significant difference in success rates of AE reduction ($p=0.799$).

Regarding clinical presentations, the symptoms which were more likely to obtain failed AE reduction

included lethargy, abdominal distension and bloody stool. During physical examination, fever (body temperature over 37.8 degree Celsius), abdominal distension, palpable abdominal and rectal mass, mucous bloody stool and dehydration were noted to have high failure rates of AE reduction (Table 2).

Of the 284 episodes of intussusception with AE reduction, plain abdominal films revealed complete intestinal obstruction in 81 episodes (28.5%). Those patients with complete intestinal obstruction (Figure 3) who were treated by AE reduction had failure rates as high as 46.9% ($p<0.001$, RR = 2.704, 95% CI = 1.575-

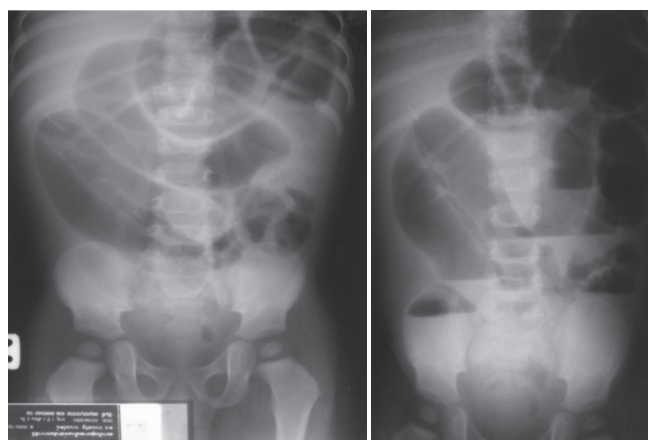


Figure 3 Complete intestinal obstruction from plain films of abdomen

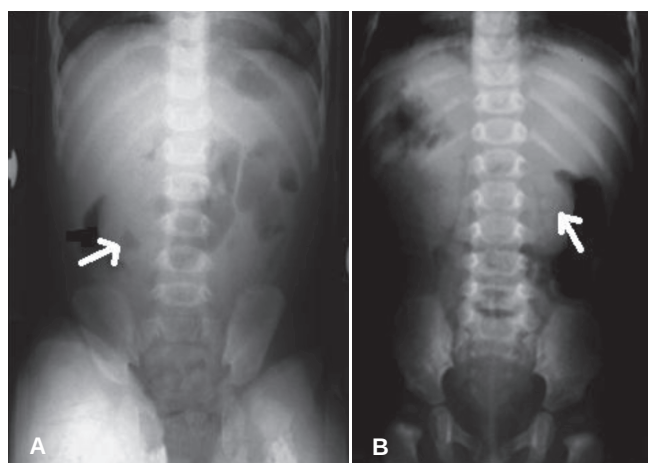


Figure 4 Radiological findings of soft tissue mass, A. in the right side, B. in the left side of abdomen

4.644). Soft tissue masses were showed in abdominal films of 158 episodes (55.6%). Patients with visible soft tissue mass in the left side of abdomen (Figure 4) tended to have higher failure rates than those in the right side of abdomen ($p < 0.001$, RR = 6.924, 95% CI = 3.219-14.892).

Successful AE reduction was obtained in 196 episodes (69.0%) and 9 of the 196 episodes (4.6%) revealed spontaneous reduction with unknown site of intussusception. Six of 88 episodes (6.8%) of failed AE reduction were surgically proven small bowel intussusception. Intussusception at sigmoid and rectum (Figure 5) had significant higher failure rate of AE reduction than other sites (Table 3).

Among these 268 patients, there was no mortality,

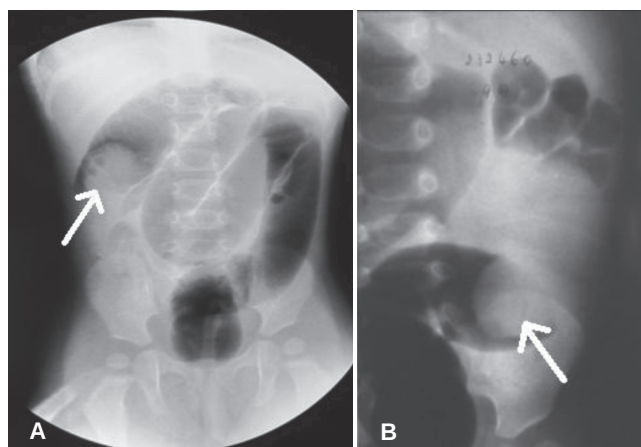


Figure 5 Locations of intussusception in the colon during AE reduction, A. at the hepatic flexure. B. at the sigmoid colon

but complications related with AE reduction occurred in 10 cases (3.7%). Two cases of the 196 successful AE reduction (1.0%) developed pneumonia, while 8 cases of the 88 failed AE reduction (9.1%) had massive rectal bleeding (1), aspiration pneumonia (2), seizure (2) and colonic perforation (3) during AE procedure. Five of the eight complication cases had evidences of complete intestinal obstruction in plain films of abdomen, especially two cases with colonic perforation. Complications in the failed AE reduction group was higher than those in the successful AE reduction group ($p = 0.002$, RR = 25.556, 95% CI = 4.836-96.090).

DISCUSSION

The success rate of AE reduction of intussusception in the present study was 69%. Younger or older ages at clinical presentation, a long duration of presenting symptoms and radiological finding of complete small bowel obstruction are not contraindications for AE reduction at our institute. Results of this study revealed that infants (0-1 year) and children over two years old had a failure rate of AE reduction approximately 40%. Surprisingly, there was no difference between duration of symptoms less than 24 hours and over 24 hours. In contrast, many investigators reported that a long duration of symptoms was a clinical predictor influencing reducibility of AE reduction⁹⁻¹³.

Presenting symptoms of lethargy, passage of bloody stool and abdominal distension significantly

Table 3 Radiological appearances from plain films of abdomen and air enema reduction

Radiological findings	AE reduction		<i>p</i> -value	Relative risk	95% confidence
	Success (%)	Failure (%)			interval
Plain films of abdomen					
Complete gut obstruction					
Yes (81)	43 (53.1)	38 (46.9)	<0.001*	2.704	1.575-4.644
No (203)	153 (75.4)	50 (24.6)			
Visible soft tissue mass in the abdomen					
Right side (107)	91 (85.0)	16 (15.0)	<0.001*	6.924	3.219-14.892
Left side (51)	23 (47.9)	28 (52.0)			
AE reduction					
Locations of intussusception					
Rectum (6)	0 (0.0)	6(100.0)	< 0.001*	3.256	2.719-3.899
Sigmoid (61)	25 (40.9)	36 (59.0)	0.001*	2.260	1.240-4.114
Descending colon (7)	5 (71.4)	2 (28.5)	0.834	1.194	0.227-6.281
Splenic flexus (15)	10 (66.6)	5 (33.3)	0.925	0.949	0.314-2.863
Transverse colon (63)	46 (73.0)	17 (26.9)	0.358	1.382	0.739-2.583
Hepetic flexure (76)	62 (81.5)	14 (18.4)	0.002*	2.664	1.394-5.092
Ascending colon (35)	31 (88.5)	4 (11.4)	0.004*	4.227	1.443-12.389

indicated failure of AE reduction. In addition, clinical signs including fever, dehydration, abdominal distension, bloody stool, and palpable abdominal and rectal mass were strongly associated with high failure rate of AE reduction. These findings are similar to other studies¹¹⁻¹³.

Previous studies reported complete small bowel obstruction as a significant failure predictor for AE reduction including increased risk for intestinal perforation^{12,14,15}. Complete intestinal obstruction in our present study had a failure rate as high as 47% and 2 cases of these failed AE reduction developed colonic perforation. However, appearances of small bowel obstruction from plain films of abdomen are not absolute contraindication for AE reduction because an unnecessary laparotomy could be performed in approximately 50% of these patients^{16,17}. Location of the distal extent of intussusception is one of the predictors of success for AE reduction. Many studies documented a significant difference in reduction rate for intussusceptions located in the left side of colon less likely to be reduced with AE enema^{12,13,18}. Our data supported these documents. More distal extents of intussusception have a high failure rate, whereas more

proximal locations of intussusception in the right colon have a high success rate for AE reduction.

Many investigators studied childhood intussusception and found predictors of failed AE reduction which related to age, duration of clinical presentation, symptoms, signs, and many radiological findings^{9,17}. These poor predictive factors are not considered as a contraindication for AE reduction because of ability to prevent unnecessary operation in about 50% of these patients. Absolute contraindications for AE reduction are accepted in clinical evidence of intestinal perforation and peritonitis^{16,17}. We suggest some contraindications for patients with clinical instabilities such as marked abdominal distension, repeated seizure, respiratory insufficiency which tend to develop respiratory arrest during AE procedure. In addition, the patients with palpable intussusceptums in the rectum by rectal examination should avoid AE reduction because of a failure rate nearly 100% in this study.

CONCLUSION

Our present study showed that predictive factors

for failure of AE reduction included age at presentation younger than one or older than two years old, lethargy, fever, dehydration, bloody stool, abdominal distension, palpable mass both in the abdomen and the rectum, radiological signs of intestinal obstruction and extent of intussusception in the left side of colon. These predictors were not absolute contraindications for AE reduction. However, AE reduction should not be performed in the patients with palpable masses in the rectum because of nearly 100% of a failure rate.

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