

Clinical analysis of ultrasound-guided warm saline enema in the treatment of pediatric intussusception

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Abstract

Objective: Few studies have explored using ultrasound-guided warm saline enema to treat acute intussusception in children. This article aimed to assess the effect of warm saline enema on acute intussusception in children.

Methods: In this study, we retrospectively analyzed 169 children who underwent ultrasound-guided warm saline enema treatment for pediatric intussusception in 3201 Hospital, Shanxi, China between January 1, 2020, and December 31, 2022.

Results: Out of the 169 children included in the study, 156 were successfully treated, while 13 did not respond to the treatment. The success rate was 92.31%, and the failure rate was 7.69%. The reduction time and hospital stay in 169 children ranged from 9 to 54 minutes and 1 to 25 days, respectively. On average, the reduction process took about 20.84±4.86 minutes, and the hospital stay was around 3.79±2.49 days. Among the 169 children, 3 experienced nausea and vomiting, while none had postoperative diarrhea or intestinal perforation. The overall incidence of complications like nausea and vomiting was 1.78%.

Conclusions: A total of 169 children with intussusception underwent treatment using ultrasound-guided warm saline enema. The reduction time was consistent with the existing literature. Complications were small in these cases, only manifested as nausea and vomiting. These findings also provide valuable evidence for clinical management of these diseases. (*Acta gastroenterol belg.*, 2025, 88, 97-102).

Keywords: Pediatric, Intussusception, Ultrasound-guided, Warm saline enema, Treatment.

Introduction

Intussusception is a common acute abdominal condition in pediatric surgery, often seen in infants under 3 years old, especially in infants between 4 and 10 months (1, 2). Primary intussusception often occurs in the intestinal tract without pathological changes due to increased intestinal activity during the introduction of solid foods (3-5). This condition mainly affects children, with over 95% of cases being primary intussusception (3-5). Symptoms include abdominal pain, vomiting, jelly-like stools, an abdominal mass, electrolyte imbalance, and irritability (6-8). The disease progresses rapidly and can lead to intestinal necrosis after 48 hours (9-11). Intussusception can result in complications such as intestinal obstruction, compression of the intestinal tract and mesenteric vessels and potentially severe consequences like intestinal necrosis and peritonitis, posing significant risks to the health of children (9-11). Timely intervention is crucial to prevent life-threatening complications (5-7, 9-11).

Therefore, timely and effective diagnosis and treatment are crucial. However, due to children's

limited ability to communicate and the subtle clinical manifestations, diagnosing and treating intussusception can be challenging (12, 13). Therefore, the focus in clinical practice is on considering enema reduction for children with symptoms for less than 48 hours (12-14). Currently, the most commonly used method in domestic clinical practice is air enema reduction guided by X-ray (15). Many medical facilities choose to use ultrasound-guided saline enema for intussusception. As the preferred diagnostic tool for intussusception in children, ultrasound offers safety, non-invasiveness, radiation-free imaging, and high diagnostic accuracy (12, 16, 17). Saline enema reduction is economical, associated with fewer complications, offers enhanced maneuverability, and has few side effects (12, 16, 17). During the enema procedure, the pressure from the saline solution counters the abdominal muscle tension induced by children's crying. This helps increase abdominal pressure, protect the intestinal tract in the abdominal cavity, and aid in the reduction of intussusception (12, 16, 17). Studies indicate that in addition to diagnosis, ultrasound-guided saline enema can achieve a success rate of 90% in the treatment of intussusception in children (18).

However, there is limited literature on using ultrasound-guided saline enema for reducing acute intussusception in children. Therefore, this study seeks to review and analyze ultrasound-guided warm saline enema in the treatment of primary intussusception among 169 cases from January 1st, 2020 to December 31st, 2022.

Despite recent advancements in the treatment of pediatric intussusception, gaps remain in the current knowledge, highlighting the need for further research. Notably, few studies have explored the factors contributing to treatment failure with ultrasound-guided warm saline enema, and many previous studies have grouped patients with varying clinical conditions and timelines without considering these crucial differences. In this study, we aim to improve our understanding of predicting and optimizing success in non-surgical

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Submission date: 10/08/2024

Acceptance date: 20/01/2025

treatments by accounting for influential factors on failure and success rates and setting precise time-based selection criteria. The results of this study could help refine clinical protocols and assist clinicians in more promptly identifying cases that require surgical intervention.

Methods

Study design and setting and participants

We retrospectively analyzed 169 children treated for intussusception in 3201 Hospital, Shaanxi, China from January 1st, 2020, to December 31st, 2022. Inclusion criteria were (1) Primary intussusception occurred within 48 hours with good systemic condition; (2) Intussusception onset was between 48-72 hours, with a stable hemodynamic state and no multiple bloody stools; (3) Physical examination showed no signs of peritonitis; (4) There were no contraindications of enema. Exclusion criteria were (1) The onset time occurred more than 72 hours ago; (2) The onset time between 48-72 h, with multiple bloody stools, unstable hemodynamics, and unable to tolerate enema; (3) The course of the disease less than 48 hours, with adverse general conditions such as severe dehydration (increased heart rate, decreased urine volume, crying without tears), lethargy, high fever, or shock; (4) High abdominal distension, obvious abdominal tenderness, muscle tension, suspected peritonitis, or signs of digestive tract perforation in abdominal standing radiographs; (5) A history of multiple intussusception episodes (≥ 3 times) and family members considering surgical exploration; (6) Repeated or confirmed secondary intussusception; (7) Intestinal intussusception; (8) B ultrasound showing digestive tract malformations or intestinal polyps.

Clinical diagnostic criteria for intussusception

According to the clinical diagnostic criteria of the 7th edition of Pediatrics (19), the child had acute abdominal pain, abdominal distension, vomiting, paroxysmal

crying, restlessness, jelly-like bloody stool, and other symptoms. Abdominal examination may reveal a slightly mobile mass. Ultrasonography could reveal abnormal echogenic masses in the abdominal cavity. The long axis section of the masses showed a sleeve sign, while the short axis section showed a concentric circle sign or target loop.

Detection and reset methods

The Philips EPIQ5 used a high-frequency linear array probe with a frequency range of 3-12 MHz. Firstly, the child laid supine on the treatment bed, and their abdomen underwent continuous scanning with multiple sections. The ultrasound showed concentric circle sign, which confirmed the diagnosis of intussusception.

Then, a catheter with a balloon at the front end was inserted about 4 cm into the anus and 20-30 mL of water was injected to fix it. The back end of the catheter connected to a tee with a pressure gauge and the enema tube. The enema solution, heated to 38-40°C, was administered by physicians, with the enema pressure kept below 12.16 kPa. Reduction progress was monitored using an ultrasound device operated by a sonographer. Disappearance of the concentric circle sign, along with small intestine water intake and opening of the ileocecal valve, indicated successful reduction (Figure 1). Failure to achieve these indicated an unsuccessful reduction (Figure 2).

Observation index

Reduction success rate, reduction time, length of hospital stay, intussusception diameter, sleeve sign length, and incidence of complications (nausea and vomiting, postoperative diarrhea, intestinal perforation).

Statistical method

SPSS20.0 was used for statistical analysis. The measurement data were represented by ($\bar{x} \pm s$). Count data were expressed as %.

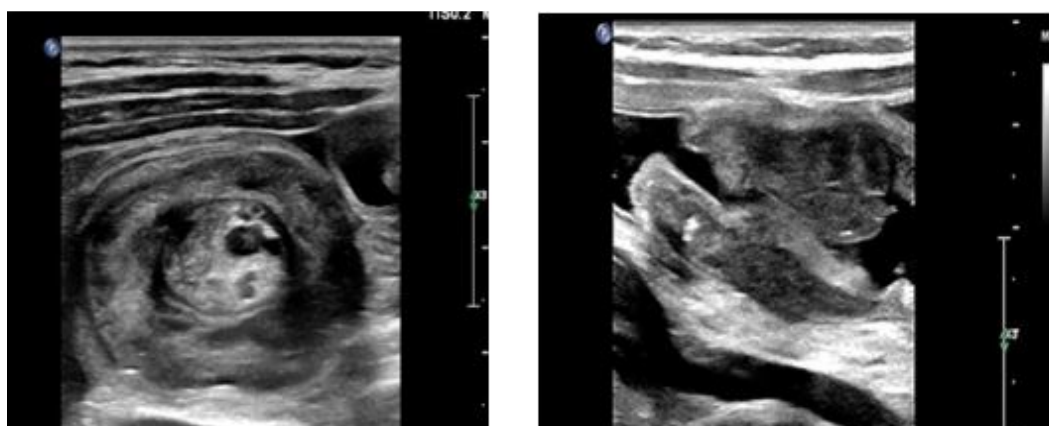


Figure 1. — One case with successful reduction before and after ultrasound images.

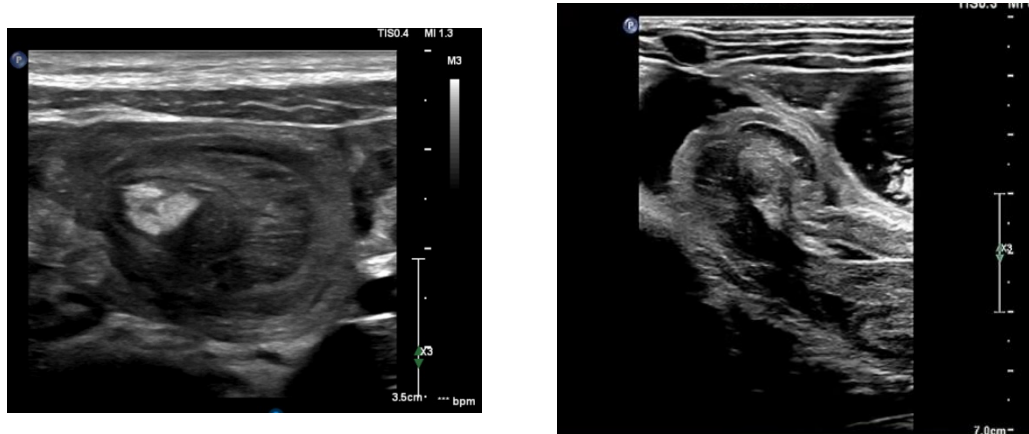


Figure 2. — Failed reduction in one patient before and after ultrasound images.

Results

The group comprised 115 males and 54 females, aged between 2 and 67 months. The course of the disease varied from 1 hour to 96 hours (Table 1).

Intussusception diameter and sleeve sign length for 169 children

As shown in Table 2, the intussusception diameter and average sleeve sign length in 169 children ranged

from 2.5 to 4.5 cm and 2.8 to 7.9 cm, respectively. The mean intussusception diameter and average sleeve sign length were (3.32±0.85) cm and (5.43±2.51) cm, respectively.

Reduction success rate

As shown in Figure 3, 156 out of 169 children were successfully reset and 13 failed. The success and failure rates were 92.31% and 7.69%, respectively.

Table 1. — Specific clinical data for 169 children.

Total case	Female/n	Male/n	Age/months	Weight/kg	Course/h
169	115	54	24.63±6.79	12.08±4.38	22.62±3.26

Table 2. — Intussusception diameter and sleeve sign length.

Total case	Intussusception diameter/cm	Sleeve sign length/cm
169	3.32±0.85	5.43±2.51

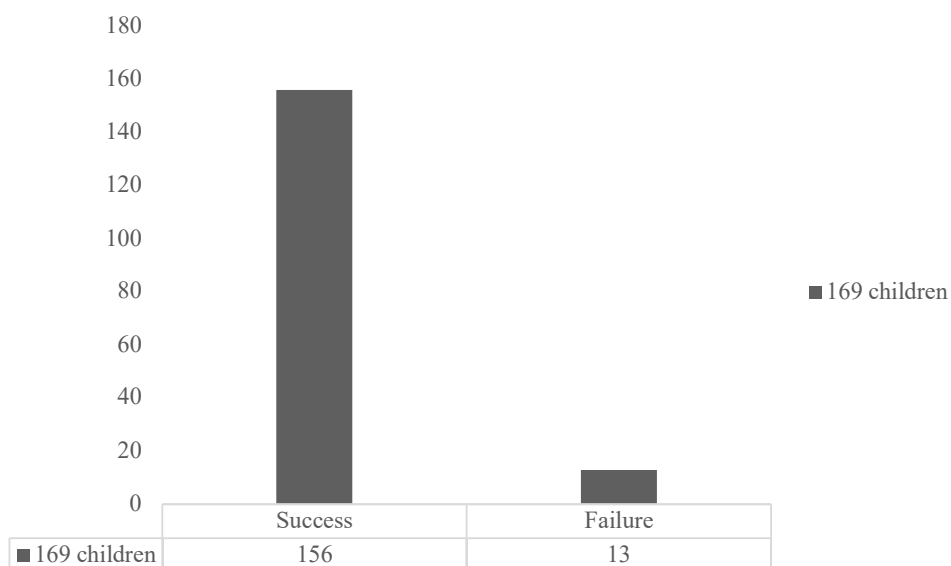


Figure 3. — Bar chart of reduction success (n).

Incidence of complications

As shown in Figure 4, out of 169 children, the occurrences of nausea and vomiting, postoperative diarrhea, and intestinal perforation were 3, 0, and 0, respectively. This yields incidence of complications of 1.78%, 0%, and 0% for nausea and vomiting, postoperative diarrhea, intestinal perforation, respectively.

Discussion

This study highlights the benefits of using ultrasound-guided warm saline enema for pediatric intussusception, emphasizing strict patient selection criteria (less than 72 hours), which improves non-surgical success rates. It also identifies factors like bowel wall thickness and inflammation as predictors of failure, aiding timely surgical decisions and improving outcomes.

Intussusception, a frequent abdominal emergency in infants and children, is primarily treated with non-surgical methods, while surgery is considered when these approaches fail (12, 20-22). Ito et.al (2012) have reported success rates ranging from 46% to 94% for non-surgical interventions, including X-ray or ultrasound-guided enemas using barium, air, or physiological saline (22). Contrary to previous beliefs, enema reduction can be considered even if intussusception onset exceeds 48 hours (23). Lim et al. (23) found success rates of 85.4% for ultrasound-guided warm saline enemas, with similar effectiveness observed in cases beyond 48 and 72 hours. The findings of our study show a higher success rate (92.31%) than Lim et al.'s study. This difference

may be due to the stricter time limit in patient selection and closer attention to predictive factors for treatment failure, such as increased bowel wall thickness and specific inflammatory conditions. Our study suggests that early identification of these factors can assist clinicians in promptly recognizing cases that may require surgery, thereby improving treatment outcomes. In our study of 169 children with intussusception, the success rate of enema reduction (92.31%) surpassed previous reports, potentially reflecting advancements in medical expertise. Among the reasons for the reduction failure in our cases were long insertion length, significant swelling of the intestinal wall, Merkel's diverticulum in the intussusception, repeated intestinal deformity, enlarged lymph nodes in the intussusception, and appendix inflammation in the sleeve.

It is currently believed that the success rate of intussusception reduction is relatively high within 48 hours (24). In our study, the reduction time ranged from 9 to 54 minutes with a mean reduction time of (20.84±4.86) minutes. This is consistent with existing literature. Studies by Nataraja and Trigylidas supported the effectiveness and safety of ultrasound-guided warm saline enema in treating intussusception, highlighting its ability to avoid radiation exposure and offer an alternative to X-ray-guided procedures (25, 26). In our research, out of 169 children, only 3 cases experienced nausea and vomiting post-procedure, indicating few adverse effects associated with ultrasound-guided warm saline enema treatment for intussusception.

In addition to the mentioned factors, the onset time, site, method of enema, and substance of enema may affect the success rate of acute intussusception reduction

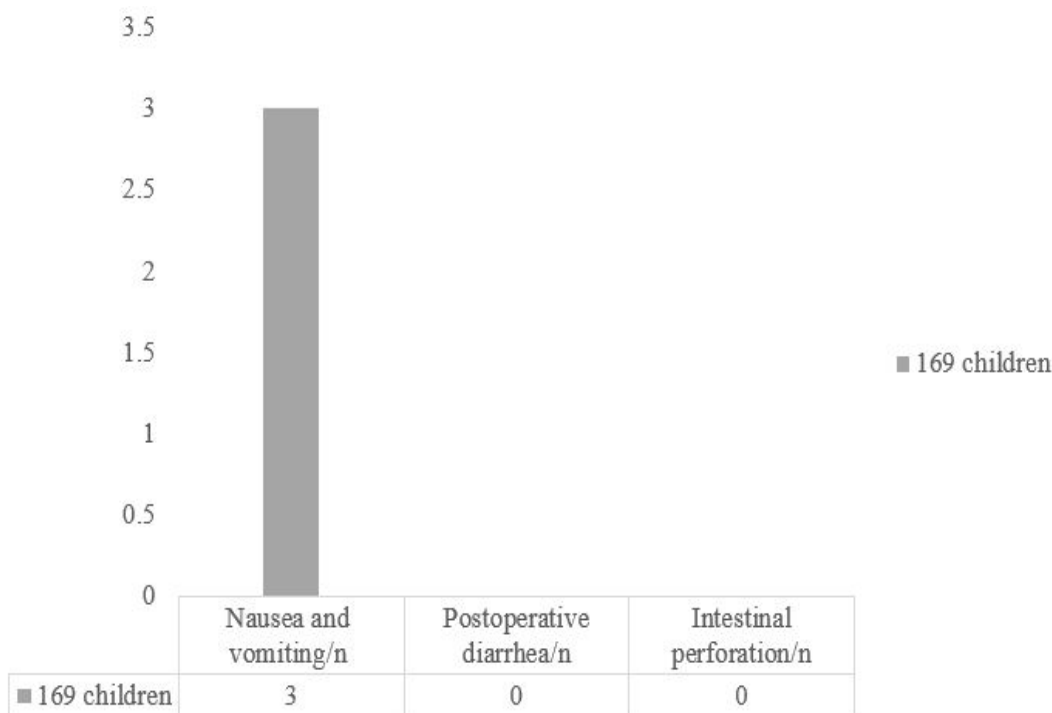


Figure 4. — Chart bar of incidence of complications of 169 children (n).

in children. Previous studies have shown that shorter intussusception time, superficial position, mild intestinal wall edema are associated with higher reduction success rates (27, 28). The current study emphasizes the importance of accurately identifying symptom onset times and other factors associated with failure in non-surgical reduction of intussusception. These findings could enhance clinical protocols and support more precise decision-making in the management of complex cases. Consequently, our study provides an essential tool for faster identification of cases needing surgical intervention, which can improve treatment outcomes and reduce potential complications.

However, this study has limitations as it is retrospective, potentially missing relevant data. Uncontrollable factors should be excluded, and the overall sample size should be expanded. A multi-center study is essential for a comprehensive evaluation of results.

Conclusions

In our study, 169 cases of intussusception in children treated with ultrasound-guided warm physiological saline enema in our hospital showed a higher reduction rate than that reported in the literature. The reduction time was consistent with existing literature and the incidence of complications among 169 children was small, primarily resulting in nausea and vomiting. Plans should involve conducting clinical comparative experiments to enhance relevant reports and provide robust evidence for the clinical management of these diseases.

Declarations

Ethics statement and informed consent: This study was approved by the Ethics Committee of the 3201 Hospital. Hospital Ethics Review [2023] No. 005. All participants gave their informed consent to the research content, and the researcher promised to keep the participants' information confidential and not to disclose it outside the investigation.

Conflict of interest statement: The authors declare that they have no conflicts of interest and no financial interests related to the material of this manuscript.

Funding: Science and Technology Department of Shaanxi Province General Project - Social Development field No. 2021SF-044

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