BMC Pediatrics

RESEARCH

Open Access

Clinical manifestation and treatment of intussusception in children aged 3 months and under : a single centre analysis of 38 cases

Hongxi Guo[1†], Haiyan Lei[1†], Juan Luo[2†], Jun Yang[1*], Hongqiang Bian[1], Hu Yang[1] and Qin Guo[1*]

Abstract

Background Intussusception is the leading cause of acute abdominal conditions in infants, yet it is frequently under-recognised in those younger than 3 months, potentially resulting in serious complications such as bowel necrosis, peritonitis, or even death if not promptly treated. This retrospective study aims to enhance clinicians' understanding of the diagnosis and management of acute intussusception in this age group to prevent poor prognosis.

Methods The clinical data of 38 infants aged ≤ 3 months diagnosed with intussusception at Wuhan Children's Hospital between January 2013 and July 2024 were retrospectively analyzed. Patients were categorized into two groups based on the outcome of nonoperative reduction: the successful group and the failed group. The study examined demographic characteristics, clinical presentations, imaging findings, treatment modalities, and outcomes to identify patterns and evaluate the effectiveness of diagnostic and therapeutic approaches.

Results During the study period, 12,206 children were diagnosed with intussusception, including 38 (0.31%) infants aged 3 months or younger (mean age: 73.6 days; 20 males and 18 females). The most frequently reported symptoms were vomiting (36 cases), bloody stool (27 cases), and intermittent crying (18 cases). Ultrasonography (USG) confirmed the diagnosis in 97.4% of cases. A total of 27 (71.1%) infants treated with enema reduction, with a success rate of 48.1% (13/27). Enema-related perforation occurred in 2 cases (7.4%). An additional 11 cases (28.9%) proceeded directly to laparotomy, with 5 (15.8%) diagnosed as secondary intussusception. Bowel resection was necessary in 6 of the 25 surgical cases due to necrosis. Each infant responded well to treatment and was discharged in stable condition.

Conclusions The clinical manifestations of intussusception in infants aged 3 months and below are sometimes atypical. Early USG should be performed to make a clear diagnosis, and the effect of early intervention is satisfactory. In infants with good general condition, enema reduction can be attempted first with appropriate pressure monitoring to avoid bowel perforation.

Keywords Acute intussusception, Diagnosis, Infants, Enema reduction, Treatment

†Hongxi Guo, Haiyan Lei and Juan Luo contributed equally to this work.

*Correspondence:
Jun Yang
yangjun@zgwhfe.com
Qin Guo
guoqin@zgwhfe.com

[1]Department of General Surgery, Wuhan Children's Hospital, Tongji Medical College, Huazhong University of Science & Technology, Wuhan, China
[2]Department of Endocrinology and Metabolism, Wuhan Children's Hospital, Tongji Medical College, Huazhong University of Science & Technology, Wuhan, China

Introduction

Intussusception is a pathological process in which a segment of bowel twists and retracts on itself into the adjacent intestine, resulting in an intestinal obstruction [1]. Its the most common cause of intestinal obstruction in infants and young children, with a prevalence of 0.5 per 1,000 to 2 per 1,000 [2], common in children aged 4 months to 24 months, with peak incidence at 4–9 months of age [3, 4], with a very low incidence in infants under 3 months of age. The clinical presentation of intussusception in young infants is often atypical, with the disease typically being acute and rapidly progressive, frequently leading to severe complications such as intestinal necrosis, peritonitis, and even death.

Currently, the diagnosis and treatment of intussusception have been standardised, and ultrasound (US) diagnosis and non-surgical treatment with enemas have been widely accepted [2, 5–7]. However, there is still controversy as to whether conservative treatment with enemas is appropriate for small infants [8, 9]. The difficulty lies in the limitations of using low to medium pressure for enema reduction, which often fails to achieve complete reduction, as excessive or improper attempts may aggravate the condition and result in intestinal perforation. Intussusception in infants, especially those under 3 months of age, remains underreported in both domestic and international literature. Moreover, there is limited global consensus on the best management strategies for this age group, particularly in regions with variable healthcare infrastructure [10].

The purpose of this study is to analyze the clinical characteristics, diagnostic approaches, and treatment strategies for intussusception in small infants, so as to reduce the complication rate and improve the outcomes. The goal is to contribute to the global body of knowledge on this condition, highlight the challenges in its management, and offer insights into improving outcomes for affected infants.

Materials and methods

Clinical data were collected from 38 cases of intussusception in infants aged 3 months and younger admitted to Wuhan Children's Hospital (Wuhan, Hubei, China) from January 2013 to July 2024, including children's demographicdata (gender, age and weight), clinical presentation, initial diagnostic modality, imaging findings, treatment, intraoperative status, whether there was a combination of pathologic predisposing points, prognosis, follow-up and complications. The study conformed to the ethical principles detailed in the Declaration of Helsinki and was approved by the Ethics Committee of Wuhan Children's Hospital (Number: 2022R023-E01). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines. We waived informed consent since the analysis was retrospective and anonymous.

The inclusion criteria for this study were as follows: (1) infants diagnosed with the condition via US, X-ray with inflation, or confirmed through surgery, and (2) infants aged 3 months or younger. Cases of transient small bowel intussusception were excluded from the study.

Methods

US examination

A diagnostic color Doppler US machine with a 3.5–12 MHz probe was used. The child was positioned supine, and a low-frequency convex-array probe was used to scan the abdomen, followed by a high-frequency linear-array probe to assess the intussusception, its location, size, associated lymph nodes, free fluid, and pathological leading points. Color Doppler was employed to detect blood flow within the intussusception.

US-guided hydrostatic reduction (UGHR)

A disposable hydrostatic enema kit (FWB-I, Shenzhen, China) was used. The anal tube was inserted, and 37 °C saline was infused under US guidance. The intussusception was monitored for signs of reduction, such as the "island sign" and "crab claw" appearance. Pressure was initially set to 8 kPa, gradually increased to a maximum of 13.3 kPa if needed, and manual massage (the right hand gently and slowly massaging the abdomen while pushing in the direction of the intussusception's reduction) was applied to assist in reduction. Successful reduction was confirmed by the disappearance of the "concentric circle" mass and the "honeycomb" pattern in the small intestine.

Fluoroscopy-guided pneumatic reduction (FGPR)

The child was positioned supine, and an 18 F Foley catheter was inserted into the rectum. Air was injected slowly under X-ray monitoring at an initial pressure of 8 kPa, with pressure not exceeding 13.3 kPa. Manual massage was applied if reduction was unsatisfactory. Successful reduction was confirmed by the disappearance of the mass and inflation of the cecum, with air flowing back into the ileum. The child was monitored for 24 h after the procedure.

Open surgery

For infants in whom reduction was unsuccessful, emergency surgery was conducted following comprehensive preoperative preparation. During the procedure, an attempt was made to manually reduce the

intussuscepted segment, followed by pathological classification and assessment of the intestinal segment's blood circulation. If vascular compromise was suspected, the affected segment was immersed in warm physiological saline to promote blood flow restoration. Any torn serosal layers were repaired, and necrotic segments were resected and anastomosed as necessary. After successfully reducing the intussusception, the proximal 100 cm of the intestine was examined for the presence of any organic lesions.

Statistical methods

All analyses were performedusing SPSS Statistics for Windows, version 25.0 (IBM Corp). Shapiro-Wilk test was used to test for normalityof the data. The descriptive data were expressed as number and percentage for categorical data, and mean and standard deviation or median and interquartile range for continuous data. Differences were evaluated using the Pearson Chi-squared test or Fisher's exact test for noncontinuous data and Student's *t*test or Mann–Whitney *U*test for continuous data. The statistical significance level was set as two-tailed with a P-value < 0.05.

Results

Demographic characteristics and clinical manifestations

Between January 2013 and July 2024, a total of 12,206 children were diagnosed with intussusception at Wuhan Children's Hospital (Wuhan, Hubei, China). Of these, 38 cases (0.31%) involved infants aged 3 months or younger (Fig. 1). The cohort included 20 males and 18 females, with ages ranging from 3 days to 3 months (mean age: 73.6 days) and weights ranging from 4 to 8 kg (mean weight: 6.0 kg). The time from symptom onset to hospital admission varied between 5 and 72 h, with an average of 25.8 h. Clinically, the majority of infants (94.7%) presented with vomiting, and 71.1% had bloody stools. Abdominal pain, indicated by intermittent crying, was observed in 47.4% of cases. Palpable abdominal masses were found in more than half of the infants (55.3%). Other common symptoms included abdominal distension (18.4%), fever (18.4%), diarrhea (7.9%), and lethargy (2.6%) (Table 1).

Imaging findings

A total of 37 cases (97.4%) were initially diagnosed using abdominal US, achieving a diagnostic accuracy of 97.4%. One case (2.6%) with negative US results was identified through abdominal CT (Table 1). The majority of intussusceptions (78.9%) were located in the right abdomen, while 8 cases (21.1%) were located in the left abdomen. Peritoneal effusion was found in 20 cases (52.6%), mesenteric lymph node enlargement in 17 cases (44.7%), and intestinal dilation in 18 cases (47.4%). All patients underwent abdominal X-ray imaging upon admission. Among these, only 14 cases (36.8%) displayed clear signs of complete intestinal obstruction, 21 (55.3%) showed localized intestinal gas dilation, 2 (5.3%) exhibited localized gas with a soft tissue mass, and 1 case (2.6%) showed signs of ascites.

Enema findings

Twenty-seven infants (71.1%) were in good general condition, exhibiting no signs of peritonitis, significant abdominal distension, severe dehydration, toxicity, or serious complications, thus, enema reduction was attempted first. Of the 27 cases that underwent enema reduction (21 received FGPR and 6 received UGHR), 13 were successfully reduced (8 from FGPR and 5 from UGHR), resulting in a success rate of 48.1%. Two cases of intestinal perforation as a complication were observed, yielding an intestinal perforation rate of 7.4% following enema reduction. The shape of the intussusception was spherical in 17 cases (63.0%) and irregular (lobed, dumbbell-shaped, bead-shaped) in 10 cases (37%). The intussusception was located in the right half of the colon in 20 cases (74.1%) and in the left half of the colon in 7 cases (25.9%) (Table 1).

Surgical finding

Of the 25 operated infants (65.8%), 11 (28.9%) underwent direct laparotomy due to clear indications. Among the remaining 14 cases (36.8%), simple manual reduction was performed without the need for bowel resection or ileostomy; however, all these cases presented with varying degrees of serosal tears. Five cases (13.2%) were identified as secondary intussusception, which included Meckel's diverticulum in 2 cases, ileal adenomyosis in 2 cases, and ileal duplication deformity in 1 case. These five patients required resection of the affected bowel followed by primary anastomosis. Additionally, six cases (15.8%) were classified as primary intussusception with complications of lead point necrosis or perforation. Among these, three underwent segmental bowel resection with primary anastomosis, while the other three required ileostomy (Table 1). No delayed intestinal perforation or recurrence of intussusception occurred in the surgical infants.

Statistical findings

Univariate analysis of demographic characteristics, clinical symptoms, abdominal signs, laboratory tests, and imaging studies in small infants with intussusception indicated that blood in stool, CRP, PCT, percentage of neutrophils, and abdominal plain radiographs suggesting intestinal obstruction had a statistically

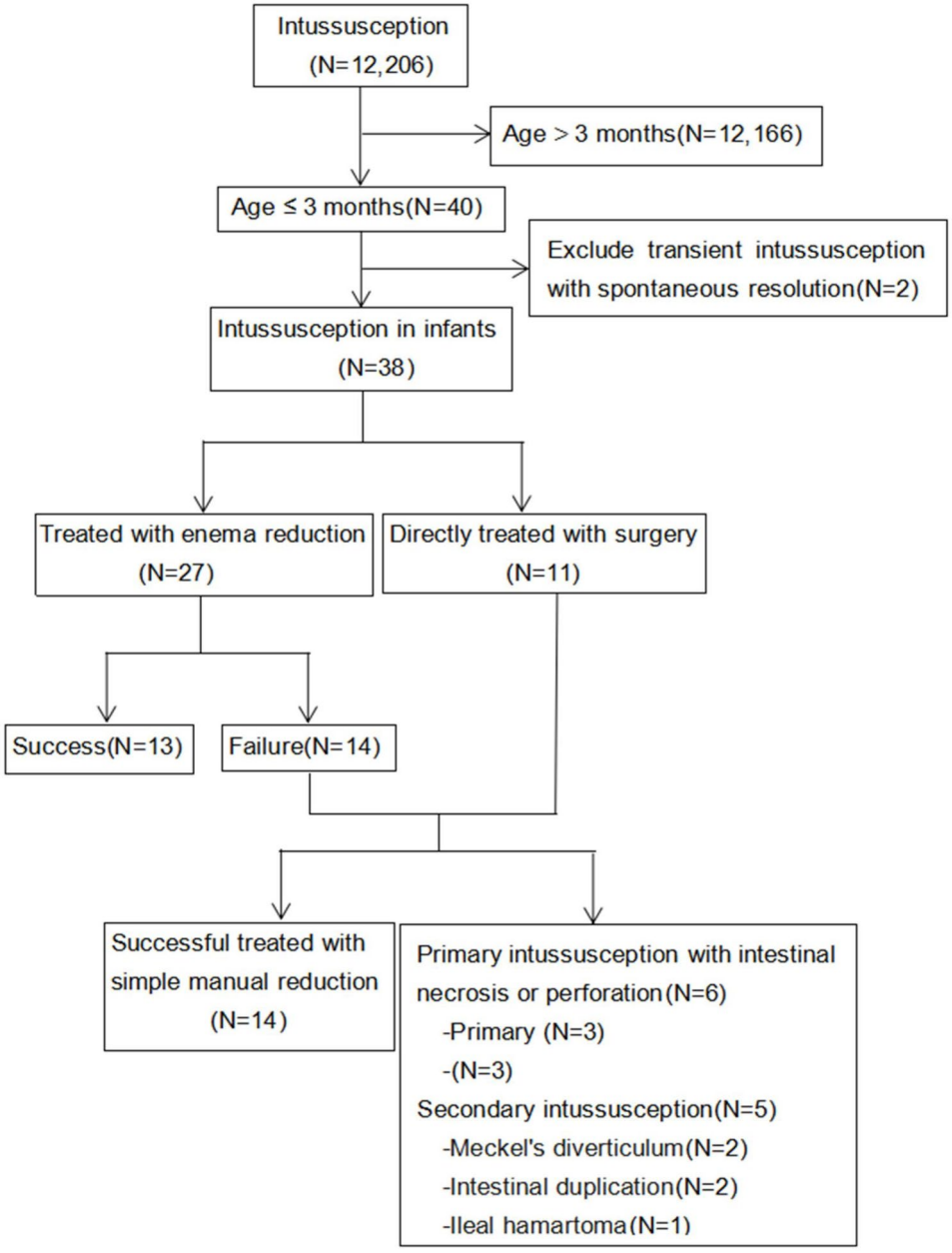

Fig. 1 Flow of the study

significant effect on the success of reduction ($P < 0.05$) (Table 2).

Prognosis and follow-up

One infant developed delayed intestinal necrosis and perforation in the ileocecal region two days after manual reduction, requiring a second surgery to resect the ileocecal portion, followed by a one-stage anastomosis. In another case, a neonate with intussusception at just 3 days old experienced bowel perforation during an enema. Surgical intervention was performed, resulting in the creation of an ileostomy. All cases were successfully treated, and the infants were discharged without any fatalities. During a follow-up period ranging from 4 weeks to 3 years (median: 3 months), all 38 children fully recovered, and no recurrence of intussusception was reported.

Discussion

Intussusception is a common acute abdominal condition in infancy and childhood, particularly in infants aged 4 to 9 months, while it is rare in the first 3 months of life. Literature reports the incidence of neonatal intussusception to be between 0% and 2.7% [1, 12–14].

Table 1 Clinical profile of intussusception in children aged 3 months and younger

Characteristics	*n* (%)
Mean age (range)	73.6 days (3 days-3 months)
Male/Female	20/18
Weight (range)	6.01 (4–8 kg)
Mean duration (range)	25.8 (5–72 h)
Clinical symptoms	
Intermittent screaming (abdominal pain)	18 (47.4)
Blood in stool	27 (71.1)
Palpable mass	21 (55.3)
Vomiting	36 (94.7)
Abdominal distension	7 (18.4)
Fever	7 (18.4)
Complementary tests	
Plain abdominal radiography	36 (94.7)
Abdominal USG	37 (97.4)
Abdominal CT	1 (2.6)
Site of intussusception	
Ileo-colic	26 (68.4)
Ileo-caecal	4 (10.5)
Ileo-ileo-colic	3 (7.9)
Ileo-ileal	2 (5.3)
Ileo-colo-colic	3 (7.9)
Associated anomalies	
Meckel's diverticulum	2 (5.3)
Intestinal duplication	2 (5.3)
Ileal hamartoma	1 (2.6)
Treatment	
Successful enema reduction	13 (34.2)
Manual reduction	14 (36.8)
Bowel resection and primary anastomosis	3 (7.9)
Ileostomy in patients with necrosis	2 (5.3)
Ileostomy in patients with perforation	1 (2.6)

USG ultrasonography

Data from our center over the last 10 years indicate that the incidence of intussusception in infants under 3 months of age is only 0.31% (38 out of 12,206 cases), with only one case diagnosed 3 days after birth.

Signs and symptoms of intussusception are often atypical in infants aged 3 months or younger [15, 16]. In our study, only 12 cases (31.6%) presented with the typical triad of symptoms: abdominal pain, bloody stools, and vomiting. When children outside the typical age range exhibit symptoms other than intermittent abdominal pain, diagnosing intussusception can be challenging and often delayed [16]. Most of the intussusception cases in this age range were referral cases to our hospital, and the majority showed clear clinical signs upon arrival. USG confirmed the diagnosis in most cases shortly after admission.

USG is the gold standard for diagnosing intussusception, offering high sensitivity (98-100%) and specificity (88-100%) when performed by experienced operators [17, 18]. Compared to contrast enema and CT, USG is safer, cost-effective, and avoids radiation exposure, making it ideal for initial diagnosis in infants with symptoms like vomiting or unexplained crying [19]. However, its accuracy may decrease with significant bowel distension, highlighting the importance of early detection [20]. Abdominal plain radiographs are simple to perform and offer valuable diagnostic information for intussusception. Their use is recommended when feasible, as they aid in differentiating intussusception from other conditions such as necrotizing enterocolitis and Hirschsprung's disease, as well as in detecting bowel perforation or necrosis. In our study, radiographs revealed complete intestinal obstruction in only 14 cases, underscoring that intussusception cannot be ruled out in young infants based solely on these findings.

FGPR is common treatment method for intussusception due to its high success rate proven effectiveness, and low complication rate [21]. Eight of our cases were successfully treated using this method.

Table 2 Influence of various factors of children with nonsurgical reduction of intussusception clustered by an age of 3 months and younger

Characteristics	Failed (*n* = 14)	Successful (*n* = 13)	*P*-value
Demography			
Male gender[a]	9 (64.29%)	6 (46.15%)	0.449
Age (days)[c]	75 (67.5,78.75)	84 (73,86)	0.109
Weight (kg)[c]	12.54 (7.84,14.07)	9.96 (6.64,10.36)	0.159
Symptoms			
Duration of symptoms (hours)[c]	22 (12,34.5)	36 (24,48)	0.181
Intermittent screaming (abdominal pain)[a]	8 (57.14%)	7 (53.85%)	1.000
Blood in stool[a]	12 (85.71%)	5 (38.46%)	0.018
Vomiting[a]	13 (92.86%)	12 (92.31%)	1.000
Abdominal distension[a]	4 (28.57%)	1 (7.69%)	0.326
Fever[a]	3 (21.43%)	3 (23.08%)	1.000
Signs			
Palpable mass[a]	5 (35.71%)	8 (61.54%)	0.257
Location (left side)[a]	3 (21.43%)	1 (7.69%)	0.596
Investigations			
WBC ($\times 10^9$ /L)[a]	12.54 (7.84,14.07)	9.96 (6.64,10.36)	0.159
Neutrophils (%)[b]	62.3 ± 15.36	45.82 ± 13.77	0.007
Hb (g/L)[a]	115 (99.25,120)	104 (101.5,106.75)	0.327
Na (mmol/L)[b]	136.79 ± 3.17	137.76 ± 1.73	0.332
Albumin (g/L)[b]	38.17 ± 4.35	39.65 ± 4.41	0.390
CRP (mg/L)[c]	7.58 (3.13,24.2)	1.5 (1,2.5)	0.006
PCT (ng/mL)[c]	0.85 (0.08,1.16)	0.03 (0.02,0.05)	0.001
Plain abdominal X-ray (small bowel[a] obstruction)	13 (92.86%)	4 (30.77%)	0.001
US (poor prognosis sign*)[a]	8 (57.14%)	4 (30.77%)	0.252

Notes: [a] Presented as *n* (%).[b] Presented as mean ± SD.[c] Presented as median (IQR). US ultrasound

*poor prognosis sign on US scans (a thick peripheral hypoechoic rim, free intraperitoneum fluid, fluid trapped within intussusceptum, enlarged lymph node in intussusception, pathologic leading point, and absence of blood flow in the intussusception) [11]

However, UGHR has increasingly replacing FGPR in many institutions due to its lack of radiation, high success rate, and minimal complications [2, 22–24]. Since its implementation in our hospital in 2019, we have seen a higher success rate with UGHR compared to pneumatic enema, with 5 out of 6 infants successfully reduced. UGHR is particularly beneficial for infants under 3 months, as it it eliminates radiation exposure and can be performed in the ward, it facilitates easier management. It allows for continuous monitoring during reduction, offers better patient comfort and is safer than pneumatic enema, which requires transfer to the radiology department. Additionally, The pressure of the hydraulic enema is uniform, which reduces irritation of the bowel and minimizes complications such as potential aspiration or risk of bowel perforation.

The applicability of conservative treatment for acute intussusception in infants younger than 3 months remains a topic of debate. A single-center retrospective analysis suggests that cautiously operated pneumatic reduction as the primary diagnostic and therapeutic approach should be considered for small infants [25]. However, some studies suggested that surgical intervention should be more readily considered for this age group, often due to the higher incidence of pathological changes associated with small bowel intussusception and the risks of failed reduction and bowel perforation stemming from the thinner intestinal walls and lower tolerance [8, 9]. Meckel's diverticulum and intestinal duplication are among the most common pathological factors. In our study, secondary factors were identified in 5 cases, representing an incidence of 13.2% (5/38), which is not considered high. In this study, enema reduction was performed in 27 cases (71.1%), yielding 13 successful attempts and a success rate of 48.1% (13/27). Although the success rate of enema reduction is not high in young infants, it still provided considerable clinical benefits compared to surgical reduction in all cases. The only adverse event that occurred during the enema procedure involved a 3-day-old neonate, who developed a bowel perforation. Based on our findings, we recommend surgery as the most reliable option for neonatal intussusception due to the fragility of neonatal intestines and the high risk of strangulation and perforation [26]. For stable small infants without dehydration, shock, or signs of peritoneal irritation, cautious hydrostatic enema reduction can be attempted, as illustrated in Fig. 2.

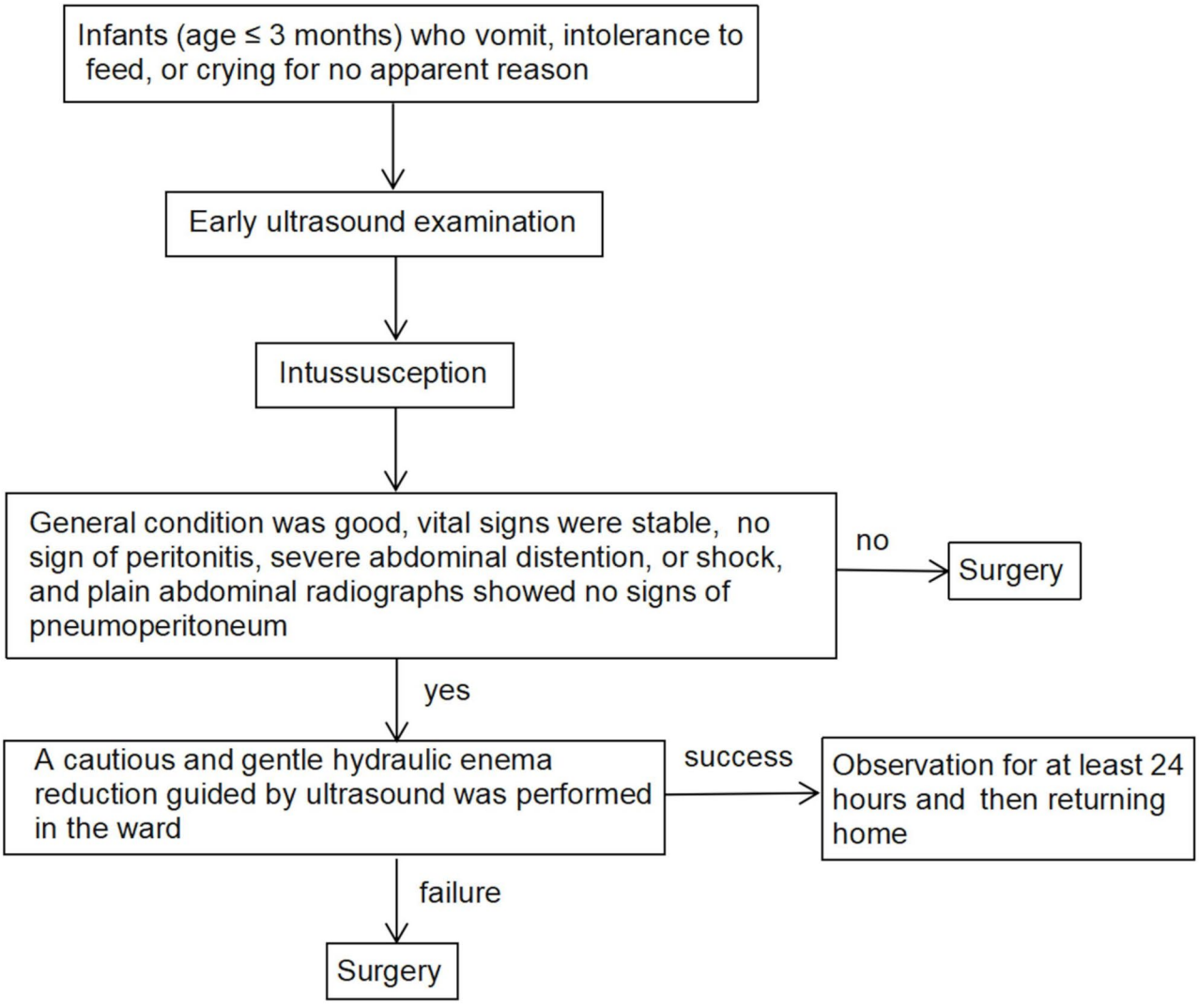

Fig. 2 Treatment strategy for intussusception in infants aged 3 months and under

Partial reduction may assist in locating the intussusception head, guiding surgical incision. Continuous monitoring of symptoms, imaging findings, and enema pressure is essential to minimize complications. Diagnostic pressure should start at 8 kPa and be carefully increased, not exceeding 13.3 kPa (10 kPa for newborns), with real-time imaging guidance.

Intussusception in young infants is a rare condition, yet it presents a significant challenge to pediatric care globally. Our study provides an important reference for pediatricians worldwide, offering valuable guidance on the safe diagnosis and management of intussusception in this specific age group. However, the study has several limitations. Due to the low incidence of intussusception in infants under 3 months, the sample size was small, limiting the generalizability of our findings. Additionally, as the study was conducted at a single, highly specialized pediatric center, the results may not fully reflect practices in settings with fewer resources. To address these limitations, future research should focus on multi-center, large-scale studies specifically examining intussusception in infants under 3 months, with particular emphasis on global variations in healthcare access and treatment outcomes.

In summary, Acute intussusception in infants under 3 months must be promptly recognized to avoid delayed treatment. For small infants in good general condition, low-pressure enema can still be employed for diagnostic and therapeutic purposes. However, the procedure should be approached with caution and care.

Abbreviations

USG	Ultrasonography
US	Ultrasound
UGHR	US-guided hydrostatic reduction ()
FGPR	Fluoroscopy-guided pneumatic reduction
Hb	Hemoglobin
Na	Serum sodium

WBC	White blood cell
CRP	C-reactive protein
PCT	Procalcitonin
SD	Standard deviation
IQR	Interquartile range

Acknowledgements
Not applicable.

Author contributions
HXG, JL and HYL carried out the studies, participated in collecting data, and drafted the manuscript. HXG, JY, QG and HQB performed the statistical analysis and participated in its design. HY and QG participated in acquisition, analysis, or interpretation of data and revised the manuscript. All authors read and approved the final manuscript.

Funding
This research was funded by Scientific Research Projects from Wuhan Municipal Health Commission (WX23A72) and Soaring Plan of Youth Talent Development at Wuhan Children's Hospital (2023TFJH01).

Data availability
All data generated or analyzed during this study are included in this published article.

Declarations

Ethics approval and consent to participate
The study conformed to the ethical principles detailed in the Declaration of Helsinki and was approved by the Ethics Committee of Wuhan Children's Hospital (Approval No. 2022R023-E01). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guidelines. Given the analysis was retrospective and anonymous, the need for informed consent was waived by the Ethics Committee of Wuhan Children's Hospital.

Consent for publication
Not applicable.

Clinical trial number
Not applicable.

Competing interests
The authors declare no competing interests.

Received: 4 October 2024 / Accepted: 7 January 2025
Published online: 26 March 2025

References

1. Bothara VP, Pandey A, Rawat J. Neonatal intussusception: a review. J Neonatal Surg. 2018;7(1):5.
2. Talabi AO, Famurewa OC, Bamigbola KT, Sowande OA, Adejuyigbe O. Sonographic guided hydrostatic saline enema reduction of childhood intussusception: a prospective study. BMC Emerg Med. 2018;18(1).
3. Huppertz HI, Soriano-Gabarró M, Grimprel E, et al. Intussusception among young children in Europe. Pediatr Infect Dis J. 2006;25(1 Suppl):S22–9.
4. Edwards EA, Pigg N, Courtier J, Zapala MA, MacKenzie JD, Phelps AS. Intussusception: past, present and future. Pediatr Radiol. 2017;47(9):1101–8.
5. C BKQA. Management of intussusception in children: a systematic review. J Pediatr Surg. 2021;56(3):587–96.
6. Plut D, Grace S, Johnston PRL, Edward Y. Practical Imaging Strategies for Intussusception in Children. AJR: American Journal of Roentgenology: Including Diagnostic Radiology, Radiation Oncology, Nuclear Medicine, Ultrasonography and Related Basic Sciences. 2020;215(6).
7. Basil, Bekdash, Sean S, Marven, Alan S. Reduction of intussusception: defining a better index of successful non-operative treatment. Pediatr Radiol. 2013.
8. Chua JHY, Chui CH, Jacobsen AS. Role of surgery in the era of highly successful air Enema Reduction of Intussusception. Asian J Surg. 2006;29(4):267–73.
9. Simanovsky N, Hiller N, Koplewitz BZ, Eliahou R, Udassin R. Is non-operative intussusception reduction effective in older children? Ten-year experience in a university affiliated medical center. Pediatr Surg Int. 2007;23(3):261–4.
10. Organization WH. Acute intussusception in infants and children: incidence, clinical representation and management: a global perspective. Geneva World Health Organization. 2002;21(3). Available from: https://iris.who.int/handle/10665/67720
11. Columbani PM, Scholz S. Intussusception. Pediatric Surgery (Seventh Edition). 2012:1093 – 110.
12. Aydin E. Intussusception in a preterm newborn. Pediatr Neonatol. 2018;59(3):312–4.
13. Awad EHA, Diwakar K, Hasan SU, Yusuf K. Multiple Intussusceptions Associated with Meconium Plugs: A Case and Literature Review. 2018.
14. Singh JK, Bawa M, Kanojia RP, Ghai B, Rao KLN. Idiopathic simultaneous intussusceptions in a neonate. Pediatr Surg Int. 2009;25(5):445–7.
15. Fischer TK, Bihrmann K, Perch M, Koch A, Wohlfahrt J, Kåre M, Melbye M. Intussusception in early childhood: a cohort study of 1.7 million children. Pediatrics. 2004;114(3):782–5.
16. Offenbacher J, Menko J, Lukovic S, Tarr M, Suzanne Roberts DO. Altered Mental Status as the primary presentation of Intussusception in a 3-Month-Old child diagnosed by Point-Of-Care Ultrasonography - ScienceDirect. J Emerg Med. 2020;58(2).
17. Hryhorczuk AL, Strouse PJ. Validation of US as a first-line diagnostic test for assessment of pediatric ileocolic intussusception. Pediatr Radiol. 2009;39(10):1075–9.
18. Carroll AG, Kavanagh RG, Ni Leidhin C, Cullinan NM, Lavelle LP, Malone DE. Comparative effectiveness of imaging modalities for the diagnosis and treatment of Intussusception: a critically appraised topic. Acad Radiol. 2017;24(5):521–9.
19. Riera A, Hsiao AL, Langhan ML, Goodman TR, Chen L. Diagnosis of intussusception by physician novice sonographers in the emergency department. Ann Emerg Med. 2012;60(3):264–8.
20. Avansino JR, Bjerke S, Hendrickson M, Stelzner M, Sawin R. Clinical features and treatment outcome of intussusception in premature neonates. J Pediatr Surg. 2003;38(12):1818–21.
21. Li Y, Zhou Q, Liu C, Sun C, Sun H, Li X, Zhang L. Epidemiology, clinical characteristics, and treatment of children with acute intussusception: a case series. BMC Pediatr. 2023;23(1):143.
22. Binu V, Nicholson C, Granger J, Gent R, Piotto L, Taranath A, Goh DW. Ultrasound guided hydrostatic enema reduction of ileocolic intussusception: a safe and effective technique. ANZ J Surg. 2023;93(7–8):1993–8.
23. Liu L, Zhang L, Fang Y, et al. Air enema reduction versus hydrostatic enema reduction for intussusceptions in children: a systematic review and meta-analysis. PLoS ONE. 2024;19(3):e0297985.
24. 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 Official J Am Inst Ultrasound Med. 2014;33(9):1669–75.
25. Kong FT, Liu WY, Tang YM, Zhong L, Wang XJ, Yang G, Chen HP. Intussusception in infants younger than 3 months: a single center's experience. World J Pediatr. 2010;6(1):55–9.
26. Kotb M, Abdelatty M, Rashwan H, AbdelMeguid Y, Elrouby A. Intussusception in preterm neonates: a systematic review of a rare condition. BMC Pediatr. 2021;21(1):587.

Publisher's note