



Independent Review Articles

Twenty years' experience for reduction of ileocolic intussusceptions by saline enema under sonography control



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ABSTRACT

Background: Ultrasonography is a well-established efficient diagnostic tool for ileocolic intussusceptions in children. It can also be used to control hydrostatic reduction by saline enemas. This reduction method presents the advantage of avoiding radiations. Parents can even stay with their children during the procedure, which is comforting for both. The purpose of this study was to present our 20 years' experience in intussusception reductions using saline enema under ultrasound control and to assess its efficiency and safety.

Material and methods: This retrospective single center study included patients with ileocolic intussusceptions diagnosed by ultrasound between June 1993 and July 2013. We excluded the data of patients with spontaneous reduction or who underwent primary surgery because of contraindications to hydrostatic reduction (peritonitis, medium or huge abdominal effusion, ischemia on Doppler, bowel perforation).

A saline enema was infused into the colon until the reduction was sonographically confirmed. The procedure was repeated if not efficient. Light sedation was practiced in some children.

Results: Eighty-three percent of the reductions were successful with a median of 1 attempt. Reduction success decreased with the number of attempts but was still by 16% after 4 attempts. The early recurrence rates were 14.5%, and 61.2% of those had a successful second complete reduction. Forty-six patients needed surgery (11 of them had a secondary intussusception). Sedation multiplies success by 10. In this period, only one complication is described.

Conclusion: Ultrasound guided intussusception reduction by saline enema is an efficient and safe procedure. It prevents exposure of a young child to a significant amount of radiation, with similar success rate. We had very low complication rate (1/270 cases or 3‰). The success rate could be increased by standardized procedures including: systematic sedation, trained radiologists, accurate pressure measurement, and number and duration of attempts.

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Ultrasonography is a well-established efficient diagnostic tool for ileocolic intussusceptions in children; it has a sensitivity rate of 98% to 100% and a specificity rate of 88% to 100% [1,2]. However, its efficiency in controlling the reduction is not well documented.

The standard treatments of ileocolic intussusceptions in children are reduction by air or contrast fluid enema, with X-ray control. The success rate with these methods is reported between 72% [3] and 87% [4]. However, these techniques expose the children to radiation while undergoing reduction (mean dose area product of 11.4 cGy cm² for air reduction [19]). Another major disadvantage of these techniques is that the child

must be separated from the parents during fluoroscopy. This is a source of stress among children and parents.

Over the last 20 years, our center has used ultrasound rather than fluoroscopy for the diagnosis and for the treatment of ileocolic intussusceptions in children. The aim of this study is to report the outcomes of this technique.

1. Patients and methods

In this retrospective single center study, we reviewed the data of all episodes of ileocolic intussusceptions diagnosed between June 1993 and July 2013. Among them, those related to attempts at hydrostatic reduction represent the body of this work (Table 1).

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We excluded the data of patients with spontaneous reduction or who underwent primary surgery because of contraindication to hydrostatic reduction (peritonitis, medium or huge abdominal effusion, ischemia on Doppler, bowel perforation).

The children's pain was evaluated with an age adapted children's pain scale. All of them received analgesia adapted to their pain score before attempted reduction (at least paracetamol). Sedation using intrarectal midazolam solution (0.4 mg/kg) was used on an ad hoc basis, depending on the clinical context.

The reduction attempt was done by a saline solution enema. The procedure was performed by the radiologists (with different levels of experience) with the presence of the pediatric surgeon, as follows: with the child in a supine position and his parents next to him, a large-bore Foley catheter was introduced in the rectum and maintained by inflating its balloon with 60 ml air; the buttocks were pressed together in order to avoid leaks. The rectal cannula was connected to a 1.5 L warm (37 °C) saline bottle suspended about 1 to 1.2 m above the table level to maintain the appropriate hydrostatic pressure in the colon for the reduction. One to 1.5 L of solution was infused into the colon under ultrasonographic control and maintained a few minutes until the reduction was obtained and the terminal ileum was filled with liquid.

The sonographic criteria for complete reduction were the total disappearance of the "target sign" and the massive flood of the small bowel attesting that there was no obstruction left in the colon or ileocecal area. If complete reduction was not achieved after 1 to 1.5 L enema, the procedure was stopped and the cannula removed to evacuate the solution. Midazolam sedation was given to the child if it was not done for the first attempt. The procedure was repeated 10 minutes later, with a maximum of 4 attempts. All patients with failed reduction underwent a surgery.

All children were kept under medical supervision and an ultrasound examination was repeated in all cases after 12 to 24 hours to exclude an early recurrence.

We analyzed the success rate depending on the intussusception etiology, localization, patient's sex, age and weight. We also analyzed the influence of sedation, symptoms duration and recurrence number on the likelihood of success.

For the statistical analysis discrete variables were expressed as counts (percentage) and continuous variables as means \pm standard deviation (SD). Frequency comparisons were done by using the chi-square test or analyzed with mixed logistic models when data were repeated. Comparisons of quantitative data were performed with generalized linear mixed models to take into account the distribution of the variable (Gamma or Poisson). Multivariate analyses were done using all variables statistically significant in bivariate analyses or according to clinical importance. A stepwise regression was performed with backward selection. $P < 0.05$ was considered significant. All analyses were performed with R 3.0.2 software and the hglm package.

2. Results

A total of 347 episodes of ileocolic intussusceptions were diagnosed during the study period. Fourteen patients were referred to our center after failed attempts at conventional fluoroscopy guide air or contrast reduction.

Table 1
Population characteristics.

Sex	168 boys 82 girls
Age (months)	23.8 (\pm 22.4)
Weight (kg)	11.6 (\pm 5.2)
Symptom duration (hours)	39 (\pm 70)
Context of intussusception	260 idiopathic 11 secondary

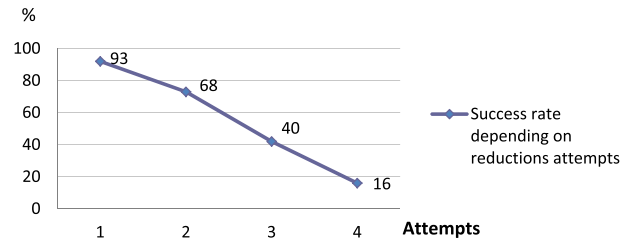


Fig. 1. Success rate depending on reductions attempts.

Fifty-six of them were treated by primary surgery because of contraindications to hydrostatic reduction. In 20, spontaneous resolution was diagnosed by ultrasound before the start of the hydrostatic reduction. Those 76 sets of data were excluded.

Thus, 271 attempts in 250 patients (21 late recurrences) were studied.

The mean age at first intussusception was 23.4 months (1.4–196.5) and the median age was 17.6 months. The median duration of symptoms before diagnosis was 24 hours (range 1–720 hours). The median hospital stay was 24 hours (range 12–840 hours).

Only 11.5% of the children were sedated by midazolam before the reduction attempt.

Of the 250 children with a first intussusception episode, 213 (85.2%) were successfully reduced initially and 37 needed surgery. Among these 213 children, 31 (14.5%) experienced one or several early recurrences within five days. Of these, 19 (61.2%) underwent further successful saline reduction, 4 (13%) were spontaneously reduced on further evaluation, and 8 (25.8%) required surgery (3 Meckel's and 5 failures of the repeated hydrostatic reduction). Thus, 205 children could be discharged without surgery (success rate of 82% with a first episode).

They were a further 21 late recurrences, occurring after a median time of 9.5 months, 20 of them were reduced with the saline enema; one failed, but the surgical exploration did not find any secondary etiology. Thus, the overall success rate for this technique is 83% (225/271).

Among the 46 patients that needed secondary surgery, we discovered, during surgery, undiagnosed secondary intussusceptions (9 Meckel's diverticula, 1 polyp and 1 lymphoma) in 11 children. A median of 1 attempt per child (range 1–4 attempts) was necessary to obtain the reduction and 4/5 intussusceptions were reduced after the first attempt. The probability of reduction decreased with the number of attempts, 93% (135/145) of success after one attempt but it was still of 16% (1/6) after the 4th attempt (cf. Fig. 1).

Eighty-eight percent of the idiopathic intussusceptions were reduced. We were able to reduce the intussusceptions of 11/14 patients referred to us after failed conventional attempts at other institutions.

The head of the intussusceptum was localized at the ileocecal valve in 40%, in the ascending colon in 45%, in the transverse in 10% and in the left colon in 5%. The success rate was 84% when located at the ileocecal valve, 94% in the ascending colon, 88% in the transverse colon and only 35% in the left colon (cf. Table 2).

The comparative statistical analysis is presented in Table 3. Neither patients' characteristics (age, gender, weight) nor clinical symptoms (vomiting, stool bleeding and symptoms duration) were associated to reduction success. The success rate was significantly associated to: idiopathic intussusceptions (OR, 115.0 [5.5–2423.1]; $P = .003$); ileocecal and ascending colon localization (OR, 174.4 [7.2–4193.7]; $P = .002$); absence

Table 2
Success rate depending on localization.

Localization	Total	Success	Failure
Ileocecal region	108 (40%)	91 (84%)	17 (16%)
Ascending colon	121 (45%)	114 (94%)	7 (6%)
Transverse colon	25 (10%)	22 (88%)	3 (12%)
Left colon	14 (5%)	5 (36%)	9 (64%)

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