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Spontaneous reduction of intussusception: clinical spectrum, management and outcome

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Abstract *Background*. To analyze the spectrum of clinical features, management and outcome of children with documented spontaneous reduction of intussusception (SROI).
Materials and methods. Review of records of 50 children (33 boys, 17 girls; age range 11 days–15 years; mean age 4 years) with documented SROI, in whom intussusception was initially diagnosed by sonography (US) in 44, air enema in 2, and computed tomography in 4, in the 6-year period 1992–1998.
Results. Symptoms suggestive of intussusception were present in 21 (3 of whom had Henoch-Schönlein purpura and 4 had previous ileocolic intussusception reduced by air enema). Intussusception was an incidental finding in the other 29, in 28 of whom the finding was in the small bowel. Intussusception was limited to the small bowel in 43 and was ileocolic in 7. SROI was usually documented on US. Laparotomy performed in only 4 showed no evidence of intussusception or pathologic lead point. Outcome in all patients was favorable.
Conclusions. SROI may present in symptomatic or asymptomatic children and occurs more commonly than previously reported. These intussusceptions are usually short-segment, small-bowel intussusceptions with no recognizable lead point. In asymptomatic patients, conservative observation is warranted. Intervention should be dictated by the clinical findings in symptomatic patients.

Introduction

In 1940, Goldman et al. [1] reported four children in whom a palpable mass, which was thought to be an intussusception, disappeared during physical examination. These authors suggested that this finding represented spontaneous reduction of an intussusception (SROI) and postulated that this occurrence was probably more frequent than commonly believed at that time. Since then, SROI has become a recognized event, but subsequent papers have reported SROI, documented by fluoroscopy or sonography (US), in only small numbers of children [2–9].

In recent years we have documented, in a variety of clinical settings, larger numbers of children with SROI than previously reported in the literature. The purpose of this paper is to present a larger series of children with SROI from one institution in order to assess the imaging findings and to analyze the spectrum of clinical features, management and outcome of these patients.

Materials and methods

We retrospectively reviewed the clinical records and imaging findings of 50 children in whom SROI was documented in the 6-year period July 1992 to September 1998. This included 33 boys and 17 girls whose ages at the time of examination ranged from 11 days to 15 years (mean = 4 years).

These patients were not all investigated with the same protocol of modalities. Investigation was directed by the variety of clinical settings that are summarized in Table 1. In several children, more than one study with a particular modality was used. The clinician

responsible for the care of each patient was consulted prior to the performance of each imaging study or procedure in all the patients.

All US studies were performed by either experienced US technologists, pediatric radiology fellows or staff radiologists. The studies routinely include an evaluation of the entire abdomen including the bowel using sector and linear transducers of high frequency (7.5–10 MHz). At no time was the abdomen or intussusception compressed or manipulated manually or by the transducer in order to induce reduction of the intussusception.

Of the 50 patients, the intussusception was initially diagnosed on US in 44, on air enema in 2, and on computed tomography (CT) in 4. The images of all of the studies in each patient were reviewed to confirm the diagnosis of the presence of intussusception. The criteria utilized to diagnose intussusception in our patients were the same as those described previously in the literature on US by Pracros et al. [10] and del-Pozo et al. [11], and on CT by Cox et al. [12].

Laparotomy was performed in four children.

Results

Clinical background

Twenty-one children (42%) presented with symptoms or signs suggestive of an intussusception (abdominal pain, vomiting or rectal bleeding). Three of these had Henoch-Schönlein purpura (HSP). Another 4 had had a previous ileocolic intussusception that had been successfully reduced by air enema.

In the other 29 children (58%), the intussusception was an incidental finding on an imaging examination done for the reasons listed in Table 1. Five of these patients had undergone abdominal surgery several months to years prior to the episode of SROI.

Table 1 Clinical background of the 29 patients in whom the intussusception was an incidental finding

	Disease	Time from last abdominal operation
I.	*Gastrointestinal*	
	Necrotizing enterocolitis	
	Chronic diarrhea	
	Appendicular abscess	
	Gastroesophageal reflux and Nissen's procedure	3 months
	Crohn's disease	Biopsy 2 days
II.	*Malignancy*	
	Teratoma	5 years
	Hepatoblastoma	5 months
	Pineoblastoma	
	Acute lymphatic leukemia (two cases)	
	Lymphoma	
III.	*Urinary*	
	Recurrent urinary tract infection (three cases)	
	Incontinence	
	Hydronephrosis	
IV.	*Others*	
	Liver transplant (two cases)	1 year and 2 weeks
	Cystic fibrosis	
	Beckwith-Wiedemann's syndrome	
	Bartter's syndrome	
	Sepsis	
	Cat-scratch disease	
	Jaundice	
	Ataxia, nystagmus	
	Blunt abdominal trauma (three cases)	
	Failure to thrive	

Diagnosis

The imaging appearances of the intussusceptions were typical in all 50 patients, having been documented on US in 44, on air enema in 2, and on CT in 4 (Figs. 1–4). In 43 (15 symptomatic, 28 asymptomatic) the intussusceptions were considered to be in the small bowel because they (1) involved only a short segment of bowel (under 5 cm), (2) were of small size, and (3) were usually centrally positioned in the abdomen or in the left upper quadrant. The other 7 intussusceptions (6 symptomatic, 1 asymptomatic) were considered to be ileocolic because of the larger size or location in the right hemiabdomen.

Sonography

Of the 44 intussusceptions diagnosed on US, 39 were considered to be in the small bowel and 5 were thought to be ileocolic. Of the 44 children, 19 were symptomatic and 25 were asymptomatic. Spontaneous reduction was also demonstrated on US in 40 of these patients (Figs. 1–3). In 39 of these the reduction occurred within 45 min of the initial demonstration of the intussusception, and in some of these reduction was noted during the real-time US examination. The remaining patient had neutropenic colitis and was managed nonoperatively; spontaneous reduction occurred by 12 h, documented on follow-up US.

In the other four patients with intussusception diagnosed on US, all four were symptomatic and were thought to have an ileocolic intussusception on US. Reduction of these intussusceptions was not demonstrated sonographically, and an air enema was required. In three of these, the air enema did not demonstrate an intussusception, suggesting interim spontaneous reduction. Review of the videotape of the procedure excluded the possibility that reduction could have proceeded so rapidly that it was initially not appreciated. In the other case, an intussusception was found on air enema in the colon but was only partially reduced; follow-up US 2 h later, before attempting another air-ene-

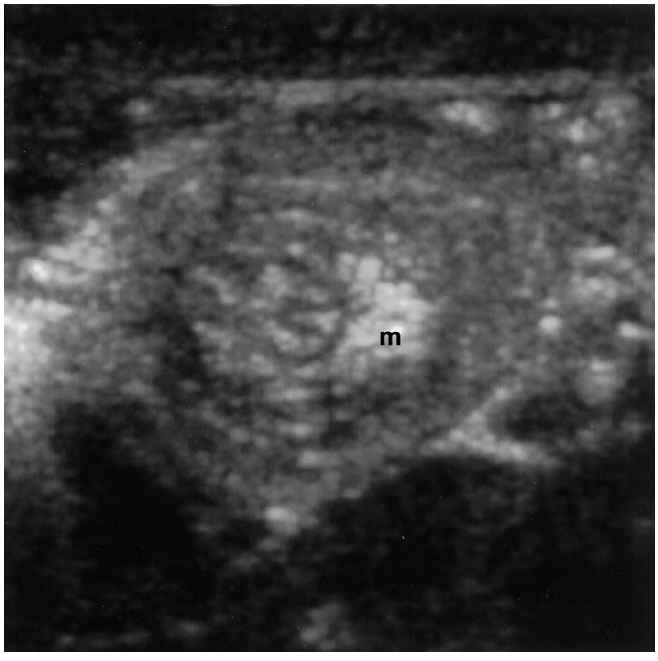

Fig. 1 Sonogram of a 2-year-old girl with ataxia and nystagmus, without symptoms suggestive of intussusception. Sonography performed to rule out the presence of a neuroblastoma. Longitudinal scan in the left lower quadrant demonstrates characteristic findings of small-bowel intussusception, which disappeared on delayed scans obtained approximately 15 min later. The intussusception has a target appearance because of the thickened intussusceptum; there is a crescent-shaped hyperchoic area (*m*) as a result of the invaginated mesentery. The appearances are typical of intussusception as described by Pracros et al. [10] and del-Pozo et al. [11]

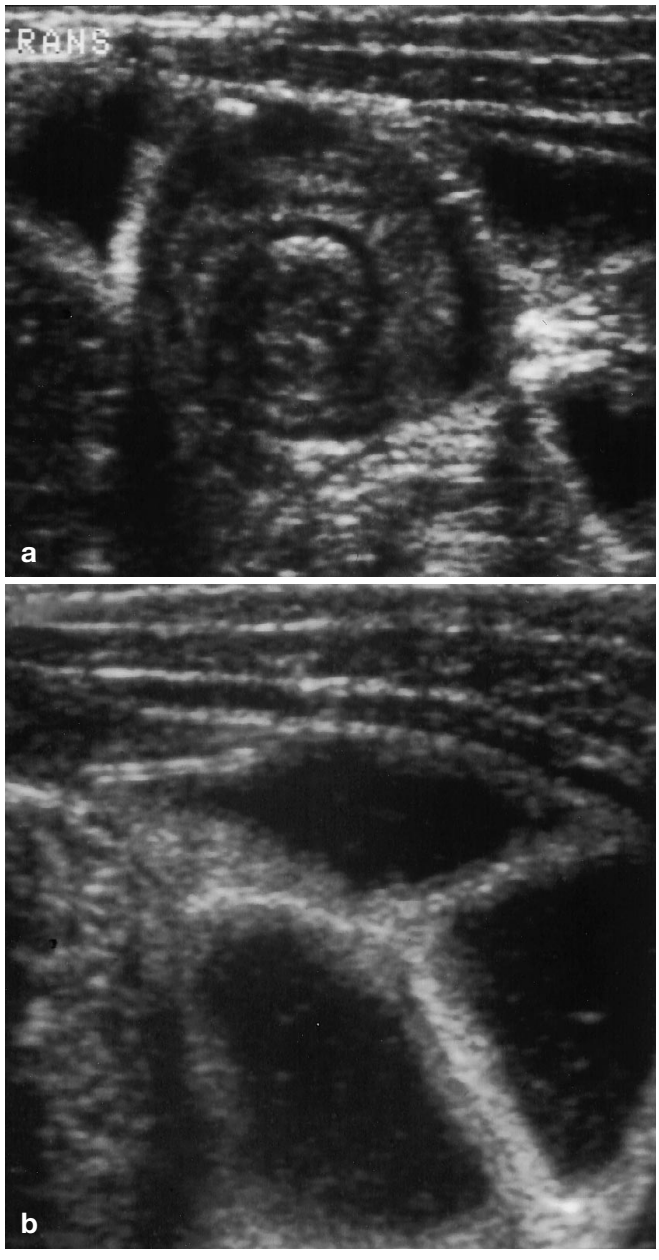

Fig. 2 a, b Sonograms of a 6-month-old boy with abdominal pain. **a** Transverse scan of the left upper quadrant shows characteristic features of small-bowel intussusception [10, 11] with surrounding bowel distension with fluid. **b** Scan in the same area as **a** a few minutes later, when the pain had resolved, demonstrates absence of the intussusception, indicating spontaneous reduction. Fluid-filled bowel loops persist

ma reduction, showed no intussusception, indicating interim spontaneous reduction.

Air enema

The diagnosis of an ileocolic intussusception was made on air enema in two symptomatic patients (6-month-old and 1-year-old girls). Only partial reduction of the intussusception was achieved with the air-enema procedure in both. The large residual mass seen in the ascending colon was in keeping with an irreducible intussusception rather than an edematous ileocecal valve. Laparotomy revealed no intussusception present, indicating interim spontaneous reduction, and no pathologic lead point was found.

CT

The intussusception was diagnosed incidentally on CT in four patients. In one, an asymptomatic 6.5-year-old boy with Bartter's syndrome, the CT showed the presence of a small-bowel intussusception in the central abdomen that was not present on delayed images, indicating spontaneous reduction (Fig. 4). In another patient, a 10-year-old asymptomatic boy having CT for routine follow-up of lymphoma, CT showed a small-

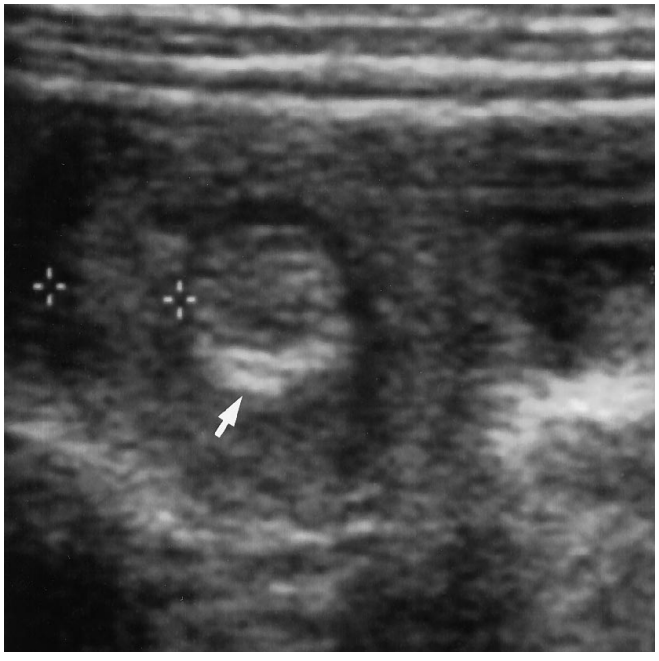

Fig. 3 Sonogram of an asymptomatic 3-year-old girl with liver transplant. Routine sonography performed to evaluate the liver graft. Axial scan in the left flank shows a small-bowel intussusception that disappeared on 45-min delayed scans. The appearances of the intussusception are characteristic [10, 11]; *white arrow* shows curvilinear echogenic area due to invaginated mesentery

bowel intussusception in the mid-abdomen, and a follow-up US 6 h later revealed that this had disappeared, indicating spontaneous reduction. In the two others (15-month-old and 13-year-old boys), CT to evaluate blunt abdominal trauma showed a small-bowel intussusception in the left upper quadrant in the former and in the center of the abdomen in the latter, which disappeared on delayed images. In neither was there clinical or CT evidence of bowel injury.

Laparotomy

Laparotomy was required in four patients. In only two was a laparotomy performed within 2 h of diagnosis of intussusception because of unsuccessful reduction by air enema. In the other two it was done electively after a delay of more than 24 h after SROI for other reasons (one for sigmoid stricture and one for colonic polyp). No intussusception was found at laparotomy in any of these four patients, indicating spontaneous reduction, and no pathologic lead points were found.

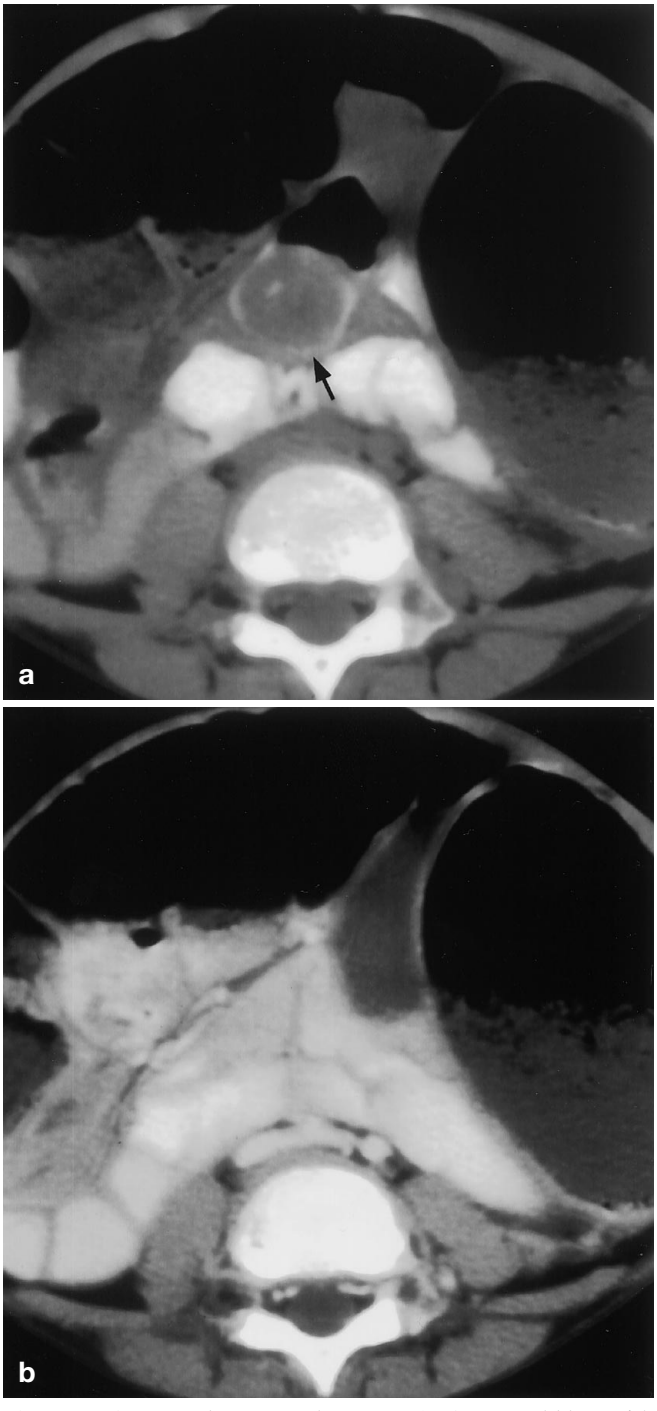

Fig. 4 a, b Computed tomography scans of a 12-year-old boy with familial dysautonomia, obtained to rule out the presence of an intra-abdominal abscess. **a** Scan shows small bowel intussusception (*arrow*). Surrounding dilated bowel is related to the familial dysautonomia. The intussusception displays characteristic features described by Cox et al. [12]. **b** A delayed scan, at same level as **a**, shows no evidence of intussusception, indicating spontaneous reduction. No residual intussusception was seen at other levels

Outcome

The outcome with regard to the intussusceptions in all 50 of these patients was favorable. After the documented episode of SROI, the clinical findings in the patients varied, depending particularly on the other associated pathologies listed in Table 1. Only 3 of the 50 patients presented with a recurrence of intussusception after the initial episode of SROI. In one of these the recurrence occurred within 24 h of the initial intussusception. The follow-up US showed a recurrent intussusception, but the patient was managed nonoperatively because of other unassociated pathology which dictated conservative management. In the other two the recurrence was seen at 1 month and 1 year after the initial episode of SROI, respectively. In both, SROI was again documented on the follow-up US.

Discussion

This paper illustrates that SROI is not an uncommon finding in children, as it occurred in about 17% of all the cases of intussusception seen in our institution during the period of our study (overall 310 intussusceptions). The larger number of patients described in this paper than in previous articles may relate to the wider use of abdominal US, improvements in resolution and quality of US images, and the better appreciation of the imaging appearances of intussusception on US and CT (Figs. 1–4).

From this series it is apparent that SROI may be seen in a heterogeneous group of patients in varied clinical settings. In this series, 42% of the children presented with symptoms or signs due to the presence of intussusception, and in only three of these was it possible to document recognizable gastrointestinal pathology (HSP), which is known to be associated with a pathological lead point. In the remaining 58%, the documentation of the intussusception was an incidental finding in children being examined for other diseases or abnormalities, some of which may predispose to the formation of these transient intussusceptions (see Table 1). In this latter group it is possible that the factors predisposing each of these individual children to the development of an intussusception were different such as: (1) swelling of the layers of the bowel wall (mucosa or Peyer's patches) as a result of chemotherapy, immunosuppression, hemorrhage or infection; (2) abnormal gastrointestinal motility secondary to drugs; (3) previous insult to the bowel wall from surgery or necrosis which creates a scar or adhesion that may serve as a lead point [13–16]. These are speculations only and were not pathologically proven to contribute to the formation of an intussusception in any of our patients.

Eighty-six percent of the intussusceptions in this series were considered to be in the small bowel because they were small, short segment (under 5 cm), and usually centrally placed in the abdomen or in the left upper quadrant. A total of 65% of these small-bowel intussusceptions were in otherwise asymptomatic children in whom no definite pathologic lead point was recognized on imaging. Robben et al. [17] have recently reported that asymptomatic small-bowel intussusceptions have a smaller diameter (mean 18 mm, in 46 children) than symptomatic intussusceptions (mean 28 mm, in 43 children). The fact that they are short segment probably allows for spontaneous reduction. Franken [3] suggested that a transitory small-bowel intussusception, documented on upper gastrointestinal (UGI) study, is an incidental, nonsignificant finding which at times may be associated with celiac disease or renal failure. These diseases were not present in any of our patients. Singleton et al. [4] suggested that transitory small-bowel intussusception, usually jejunal, is a finding that may be seen during UGI study in both symptomatic and asymptomatic children and, therefore, was of questionable clinical significance. Neither Franken [3] nor Singleton et al. [4] quoted data on how common it was to find SROI on UGI study.

This contrasts with other reports of small-bowel intussusception which have been described as occurring mainly in association with pathologic lead points or the immediate postoperative state [15, 16]. These children with these types of intussusceptions are usually symptomatic and therefore require intervention.

However, SROI has also been reported even in association with some pathologic lead points. Daneman et al. [5] reported two children with small bowel intussusception caused by pathologic lead point (one Peutz-Jegher's syndrome, one HSP) in whom spontaneous reduction was documented on UGI study. Woo et al. [6] described sonographic features in one case of transient small-bowel intussusception associated with allergic purpura in a 10-year-old girl. The spontaneous reduction documented in this case was not reported to occur in real-time. To the best of our knowledge, the only previous documented SROI in real-time, was reported by Connolly and O'Halpin [7], who described two cases with HSP in whom an intussusception was noted to form and disappear during sonographic scan.

This paper has shown that SROI is less likely to occur with ileocolic intussusceptions, which accounted for only 14% of the whole group. However, it has been reported that 10% of the radiologically nonreducible ileocolic intussusceptions have spontaneously reduced by the time the child reaches the operating room [18, 19] as was noted in two of our children. The induction of anesthesia may contribute to the spontaneous reduction, as it has been reported that it facilitates the manual reduction in the operating room [14] and increases the

success rate of a second attempt of hydrostatic reduction [20]. In 1989, Morrison and Stork [8] and, in 1994, Swischuk et al. [9] reported one and four cases, respectively, in whom ileocolic intussusceptions, diagnosed by US, disappeared by the time a contrast enema was performed. This was found in two of our patients.

Conclusion

Our series has revealed that SROI is not an uncommon finding that is seen in symptomatic as well as in asymptomatic children. The vast majority of the episodes are documented on US, and in most patients the site of the intussusception is in the small bowel. In only a few is a recognizable associated disease (such as HSP) or lead point the cause for the intussusception.

This paper has therefore shown that not all intussusceptions diagnosed on US or CT require therapeutic reduction. Small-bowel intussusceptions in particular may undergo spontaneous reduction and, furthermore, air from an air enema may not reach the site of a small-bowel intussusception. Management of all these patients will depend on the clinical findings. We recommend that when a short-segment intussusception is found, which is thought to be in the small bowel, with no recognizable lead point, particularly in an asymptomatic patient, conservative observation is warranted. Intermittent US examination over a 45-min period or repeating CT scans at appropriate levels may reveal SROI. We believe that if SROI does not occur within this period and the patient remains asymptomatic, it seems reasonable to follow these children with appropriate clinical monitoring without the necessity for repeated US examinations. Persistence of the intussusception in symptomatic children will require more immediate intervention. Surgical management will depend on the severity of the clinical symptoms.

References

1. Goldman L, Elman R (1940) Spontaneous reduction of acute intussusception in children. Am J Surg 49: 259–263
2. Teitelbaum MD, Arenson N (1950) Recurrent small intestinal intussusception in children. AJR 63: 80–88
3. Franken EA Jr (1975) Gastrointestinal radiology in pediatrics, 1st edn. Harper & Row, Hagerstown, pp 136–142
4. Singleton EB, Wagner ML, Dutton RV (1977) Radiology of the alimentary tract in infants and children, 2nd edn. Saunders, Philadelphia
5. Daneman A, Reilly BJ, de Silva M, et al (1982) Intussusception on small bowel examination in children. AJR 139: 299–304
6. Woo SK, Kim JS, Suh SJ, et al (1992) Childhood intussusception: US-guided hydrostatic reduction. Radiology 182: 77–80
7. Connolly B, O'Halpin D (1994) Sonographic evaluation of the abdomen in Henoch-Schönlein purpura. Clin Radiol 49: 320–323
8. Morrison SC, Stork E (1990) Documentation of spontaneous reduction of childhood intussusception by ultrasound. Pediatr Radiol 20: 358–359
9. Swischuk LE, John SD, Swischuk PN (1994) Spontaneous reduction of intussusception: verifications with US. Radiology 192: 269–271
10. Pracros JP, Tran-Mihn VA, Morin de Finfe CH, et al (1987) Acute intestinal intussusception in children. Contribution of ultrasonography (145 cases). Ann Radiol 30: 525–530
11. del-Pozo G, Albillos JC, Tejedor D, et al (1999) Intussusception in children: current concepts in diagnosis and enema reduction. Radiographics 19: 299–319
12. Cox TD, Winters WD, Weinberger E (1996) CT of intussusception in the pediatric patient: diagnosis and pitfalls. Pediatr Radiol 26: 26–32
13. Knowles MC, Fishman EK, Kuhlman JE, et al (1989) Transient intussusception in Crohn disease: CT evaluation. Radiology 170: 814
14. Parker BR (1993) The small intestine. In: Silverman FN, Kuhn JP (eds) Caffey's pediatric X-ray diagnosis: an integrated imaging approach, vol 1, 9th edn. Mosby, St Louis, pp 1076–1085
15. Mollitt DL, Ballantine TVN, Grosfeld JL (1979) Postoperative intussusception in infancy and childhood: analysis of 119 cases. Surgery 86: 402–408
16. Kiesling VJ, Tank ES (1989) Postoperative intussusception in children. Urology 33: 387–389
17. Robben SGF, Maertzdorf M, van Nuenen J, et al (1998) Asymptomatic small bowel intussusception in children (abstract). Presented at the 35th Congress of the European Society of Pediatric Radiology, Rhodes, Greece
18. Ein SH, Stephens CA (1971) Intussusception: 354 cases in 10 years. J Pediatr Surg 6: 16–27
19. Ein SH, Alton DJ, Palder SB, et al (1997) Intussusception in the 1990s: has 25 years made a difference? Pediatr Surg Int 12: 374–376
20. Collins DL, Pinckney LE, Miller KE, et al (1989) Hydrostatic reduction of ileocolic intussusception: a second attempt in the operating room with general anesthesia. J Pediatr 115: 204–207