

# Computed Tomography Findings of Unanticipated Prolonged Ileocolic Intussusception in Children

Devin Puapong, MD  
 Steven L Lee, MD, FACS, FAAP  
 Gary Radner, MD  
 Peter I Tsai, MD  
 Douglas S Katz, MD  
 Maher A Abbas, MD,  
 FACS, FASCRS  
 Harry Applebaum, MD

## Abstract

**Background:** Attempted nonsurgical reduction of ileocolic intussusceptions after 48 hours is controversial because of the low probability of reduction and an increased risk of perforation. We sought to retrospectively identify computed tomography (CT) criteria that may help to predict bowel viability and successful enema reduction in children with ileocolic intussusception.

**Methods:** Unanticipated intussusception was diagnosed using CT in six children with mild, atypical symptoms of four to seven days' duration at a single institution during a one-year period. All patients underwent laparotomy without prior contrast enema. Surgical findings were compared with preoperative CT scan findings to identify any criteria that may predict successful nonsurgical management.

**Results:** Contrast CT scan findings were diagnostic of ileocolic intussusception. At the time of laparotomy, three children had easily reducible ileocolic intussusception with nonischemic bowel. Two children had irreducible intussusception with ischemic bowel requiring resection, and one child had a difficult reduction of nonischemic but edematous bowel. Preoperative CT scan findings correlated well with intraoperative findings for all patients. Findings of bowel-wall edema of the intussusciens and partial small-bowel obstruction shown on CT were associated with intussusception that was nonreducible or difficult to reduce.

**Conclusion:** Patients with prolonged intussusception diagnosed using CT scan may safely undergo contrast enema reduction if no bowel-wall edema of the intussusciens or obstruction is demonstrated.

Contrast enema is the traditional diagnostic test for evaluation and treatment of ileocolic intussusception in children. More recently, reduction with air has also been used. The success of nonsurgical reduction by means of contrast or air enema of ileocolic intussusception is inversely proportional to the duration of symptoms. Prolonged symptoms (>48 hours) are usually associated with a low chance of successful enema reduction and an increased risk of perforation.<sup>1-4</sup> Despite recent data that contradict this notion, children with a delayed diagnosis of ileocolic intussusception are routinely treated with urgent laparotomy at our institution.<sup>5</sup>

Intraluminal eccentrically located fat and a target sign are computed tomography (CT) findings diagnostic for ileocolic intussusception.<sup>6</sup> At our institution, the increased use of CT scanning to evaluate nonspecific abdominal complaints has led to an increased rate of diagnosis of unsuspected intussusception in children. In an atypical presentation for this disease, these patients had prolonged, relatively minor abdominal pain. We therefore retrospectively attempted to identify specific CT criteria that might have predicted safe and successful enema reduction, despite prolonged symptom duration. These findings could obviate the need for routine exploratory laparotomy in appropriate children.

## Materials and Methods

Our study was exempted by the institutional review board at Kaiser Permanente Los Angeles Medical Center. The pediatric surgery database at our institution was analyzed for a one-year period, and a retrospective review of pediatric patients in whom ileocolic intussusception was diagnosed by CT imaging was performed. Because of existing Radiology Department policy,

**Devin Puapong, MD**, is a Pediatric Surgery Resident at the Children's Hospital of Oklahoma in Oklahoma City. E-mail: [devin-puapong@ouhsc.edu](mailto:devin-puapong@ouhsc.edu).

**Steven L Lee, MD, FACS, FAAP**, is the Chief of Pediatric Surgery, Associate Program Director of General Surgery, and Education Chair for the Department of Surgery at the Los Angeles Medical Center in CA. E-mail: [steven.l.lee@kp.org](mailto:steven.l.lee@kp.org).

**Gary Radner, MD**, is a Radiologist at the Los Angeles Medical Center in CA. E-mail: [gary.w.radner@kp.org](mailto:gary.w.radner@kp.org).

**Peter I Tsai, MD**, is a Cardiothoracic Surgery Fellow in the Baylor College of Medicine in Houston, TX. E-mail: [ptsaimd@hotmail.com](mailto:ptsaimd@hotmail.com).

**Douglas S Katz, MD**, is Division Chief in the Department of Radiology, Winthrop-University Hospital, Mineola, NY. E-mail: [dkatz@winthrop.org](mailto:dkatz@winthrop.org).

**Maher A Abbas, MD, FACS, FASCRS**, is an Assistant Clinical Professor of Surgery at UCLA; the Chief of Colon and Rectal Surgery and the Educational Chair for the Department of Surgery at the Los Angeles Medical Center in CA. E-mail: [maher.a.abbas@kp.org](mailto:maher.a.abbas@kp.org)

**Harry Applebaum, MD**, is a Pediatric Surgeon at the Los Angeles Medical Center in CA. E-mail: [harry.applebaum@kp.org](mailto:harry.applebaum@kp.org).

**Table 1. Pediatric patients whose intussusception was diagnosed using computed tomography scanning**

Patient	Age (months)	Sex	Duration of symptoms (days)	Scan findings		Surgical findings
				Small bowel obstruction	Bowel edema	
1	5	M	3	No	No	Easily reducible intussusception
2	17	M	7	No	No	Easily reducible intussusception
3	6	M	7	No	No	Easily reducible intussusception
4	24	F	5	Yes	Yes	Gangrenous bowel requiring resection
5	11	F	4	Yes	Yes	Gangrenous bowel requiring resection
6	19	F	5	Yes	Yes	Edematous bowel, manually reduced with some difficulty

patients with symptoms lasting longer than 48 hours were referred for exploratory laparotomy without any attempt at image-guided reduction. Surgical findings were correlated with preoperative CT images. All CT scans were reviewed by a single pediatric radiologist (G.R.) who was unaware of the surgical findings. CT findings, including presence of a target sign, evidence of bowel-wall edema of the intussusciens, and evidence of small-bowel obstruction, were noted. Patient data, including age, sex, duration of symptoms, and initial white blood cell count, were also obtained.

## Results

Six pediatric patients (three boys and three girls with an average age of 13.7 months; range, 5–24 months) with vague abdominal complaints of unclear etiology were shown by CT scan to have ileocolic intussusception (Table 1). The average duration of symptoms before diagnosis was 5.5 days (range, 4–7 days), and the average white blood cell count at the time of admission was  $9.4 \times 10^3/\text{mm}^3$  (range,  $4.5\text{--}18.0 \times 10^3/\text{mm}^3$ ).

Contrast CT scans of patients 1 through 3 showed findings diagnostic of intussusception with no bowel-wall edema and mild inflammatory changes but without evidence of obstruction or perforation (Figure 1). Surgical findings in these patients correlated with CT findings, and all had easily reducible ileocolic intussusception with nonischemic bowel. CT scans of patients 4, 5, and 6 showed intussusception with significant partial small-bowel obstruction and bowel-wall edema (Figure 2), which also correlated well with surgical findings. Patients 4 and 5 required bowel resection because of irreducible intussusception with areas of ischemia and necrosis, whereas patient 6 underwent a difficult manual reduction of nonischemic but edematous bowel.

## Discussion

Ileocolic intussusception is the most common cause of bowel obstruction in children younger than two

years. When the condition is promptly diagnosed, contrast or air enema successfully reduces the intussusception in the majority of patients. However, surgical management has been the standard treatment for patients with a delayed presentation of intussusception (>48 hours). Nonsurgical reduction has been infrequently attempted in these patients because of the decreased probability of success and the increased potential for perforation.<sup>1–4</sup> However, recent data have shown that successful hydrostatic reduction is not influenced by symptom duration.<sup>5</sup> Despite this finding, surgical intervention has remained the treatment of choice in children with delayed diagnosis at our institution.

With the increasing use of CT scans in patients with atypical abdominal complaints, unsuspected intussusceptions have been more frequently diagnosed. CT appearance of intussusception include a target sign, a sausage-shaped mass of different layers of attenuation, and/or a less-defined kidney-like mass. It is thought that this variation in appearance corresponds to a spectrum of stages in disease progression, representing increasing bowel-wall edema and vascular compromise.<sup>7,8</sup>

It is important to note that we are not advocating the use of CT scan as the primary imaging modality for patients with suspected intussusception. Rather, all patients in our series were initially suspected of having other intra-abdominal pathology, most commonly appendicitis, and intussusception was an unexpected finding of scanning. This has been an increasingly common occurrence at our institution and may be related to the increased use of CT scanning in the pediatric population.

The ability to correlate CT scan results and surgical findings in children with a delayed diagnosis of intussusception has enabled the development of imaging criteria that may indicate which patients may still safely and effectively undergo cautious attempts at barium enema or air reduction. In our limited series, the absence of significant bowel-wall edema and bowel obstruction on CT scan was a good indication that the bowel

... the absence of significant bowel-wall edema and bowel obstruction on CT scan was a good indication that the bowel remained nonischemic and easily reducible.



Figure 1. Computed tomography scan of patient 2 demonstrates the classic target sign in the ascending colon (arrow). There is no evidence of bowel-wall edema of the intussusciens or of small-bowel obstruction. Cautious attempt at nonsurgical enema reduction would be advised.

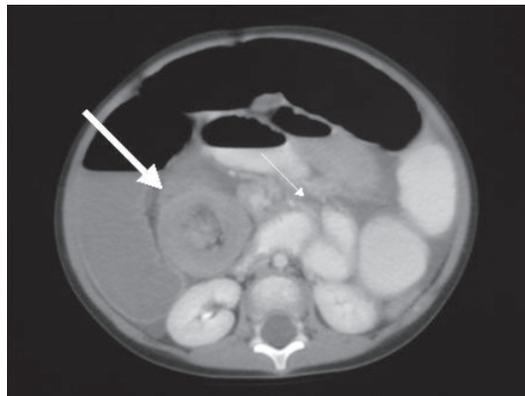


Figure 2. Computed tomography scan of patient 4 demonstrates target sign (large arrow), bowel-wall edema of the intussusciens (small arrow), and dilated small bowel consistent with obstruction. Surgical management would be recommended in this situation.

remained nonischemic and easily reducible. Surgical intervention can likely remain a secondary management option in patients with these findings. Ultrasound diagnosis, although not used in our series, may also have similar prognostic potential.<sup>9-12</sup> As always, a pediatric surgeon should be involved in nonsurgical attempts to reduce these potentially hazardous intussusceptions.

Finally, our study was limited by its retrospective nature and the small number of patients involved. In addition, we made no attempt to reduce the intussusception identified on CT scan using contrast enema. Despite these limitations, we believe that children with prolonged ileocolic intussusception diagnosed by CT scan may safely undergo attempted contrast enema reduction on the basis of CT scan findings.

## Conclusion

Children presenting with prolonged ileocolic intussusception (ie, intussusception that has lasted more than 48 hours) may safely undergo contrast enema reduction if no bowel-wall edema of the intussusciens or small-bowel obstruction is noted on CT scanning, no peritonitis is found on examination, and no free air is seen on radiographic imaging. ❖

## Disclosure Statement

The author(s) have no conflicts of interest to disclose.

## Acknowledgment

Katharine O'Moore-Klopf of KOK Edit provided editorial assistance.

## References

- Lui KW, Wong HF, Cheung YC, et al. Air enema for diagnosis and reduction of intussusception in children: clinical experience and fluoroscopy time correlation. *J Pediatr Surg* 2001 Mar;36(3):479-81.
- Okuyama H, Nakai H, Okada A. Is barium enema reduction safe and effective in patients with a long duration of intussusception? *Pediatr Surg Int* 1999;15(2):105-7.
- Sandler AD, Ein SH, Connolly B, Daneman A, Filler RM. Unsuccessful air-enema reduction of intussusception: is a second attempt worthwhile? *Pediatr Surg Int* 1999;15(3-4):214-6.
- Ein SH, Mercer S, Humphry A, Macdonald P. Colon perforation during attempted barium enema reduction of intussusception. *J Pediatr Surg* 1981 Jun;16(3):313-5.
- van den Ende ED, Allema JH, Hazebroek FW, Breslau PJ. Success with hydrostatic reduction of intussusception in relation to duration of symptoms. *Arch Dis Child* 2005 Oct;90(10):1071-2.
- Cox TD, Winters WD, Weinberger E. CT of intussusception in the pediatric patient: diagnosis and pitfalls. *Pediatr Radiol* 1996;26(1):26-32.
- Byrne AT, Geoghegan T, Govender P, Lyburn ID, Colhoun E, Torreggiani WC. The imaging of intussusception. *Clin Radiol* 2005 Jan;60(1):39-46.
- Strouse PJ, DiPietro MA, Saez F. Transient small-bowel intussusception in children on CT. *Pediatr Radiol* 2003 May;33(5):316-20.
- Crystal P, Hertzanu Y, Farber B, Shabshin N, Barki Y. Sonographically guided hydrostatic reduction of intussusception in children. *J Clin Ultrasound* 2002 Jul-Aug;30(6):343-8.
- Shehata S, El Kholi N, Sultan A, El Sahwi E. Hydrostatic reduction of intussusception: barium, air, or saline? *Pediatr Surg Int* 2000;16(5-6):380-2.
- Gu L, Zhu H, Wang S, Han Y, Wu X, Miao H. Sonographic guidance of air enema for intussusception reduction in children. *Pediatr Radiol* 2000 May;30(5):339-42.
- González-Spinola J, Del Pozo G, Tejedor D, Blanco A. Intussusception: the accuracy of ultrasound-guided saline enema and the usefulness of a delayed attempt at reduction. *J Pediatr Surg* 1999 Jun;34(6):1016-20.