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# Distinguishing Features of Self-limiting Adult Small-Bowel Intussusception Identified at CT<sup>1</sup>

**PURPOSE:** To determine if clinical or computed tomographic (CT) findings can be used to distinguish self-limiting cases of adult small-bowel intussusception from those requiring surgery.

**MATERIALS AND METHODS:** Thirty-seven cases of adult small-bowel intussusception were identified by a retrospective computerized search of 69,040 abdominopelvic CT examinations performed over a 4-year period. Two independent readers recorded CT features. Clinical findings and outcomes were determined by review of all available medical records. Outcome was classified as either surgical or self-limiting. Association between predictive variables and outcome was assessed by the Fisher exact test and logistic regression models. A multivariate, stepwise, logistic regression model was used to determine the best predictors of outcome.

**RESULTS:** Six patients (16%) underwent surgery, and all had lead-point tumors. Thirty-one patients were cared for conservatively (84%) and none required surgery at a mean follow-up of 5.2 months (range, 0–46 months). Multivariate, stepwise, logistic regression analysis showed intussusception length was the only variable that was independently predictive of outcome. All 20 patients with an intussusception length of 3.5 cm or less, as measured by either reader, had cases that were self-limiting. Seventeen patients had an intussusception length greater than 3.5 cm, as measured by either reader. Eleven patients had an intussusception that was self-limiting, and six patients had an intussusception that required surgery.

**CONCLUSION:** Intussusception length is the main factor in distinguishing the majority of small-bowel intussusceptions detected at CT that are self-limiting from the minority that require surgery. An intussusception that is shorter than 3.5 cm is likely to be self-limiting.

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Adult small-bowel intussusception has traditionally been regarded as a condition that requires surgery, because up to 90% of cases are said to be associated with a lead-point tumor or other abnormality (1–7). However, the reported frequency of lead-point disease is generally based on surgical series in which patients presented with obstructive symptoms and the diagnosis of intussusception was made intraoperatively. These results may not be applicable to adult intussusception identified at computed tomography (CT), since more recent studies suggest that many of these cases may represent self-limiting intussusception (8,9). We undertook this study to determine if clinical or CT findings can be used to distinguish self-limiting cases of adult small-bowel intussusception from those requiring surgery.

## MATERIALS AND METHODS

### Subjects

This was a retrospective single-institutional study. The study was approved by our Committee for Human Research, and written informed consent was not required. We

conducted a computerized search of all 69,040 reports of abdominopelvic CT in adult patients performed between January 1997 and December 2001. We included in the study all patients who had CT evidence of small-bowel intussusception. Reports were searched for the character string "intussuscept." Adult patients were defined as those who were 18 years of age or older. Thirty-seven patients (0.05%) with adult small-bowel intussusception were identified (19 men, 18 women). The mean patient age was 39.5 years (range, 19–69 years). A small-bowel intussusception was considered to be present at CT when an intraluminal soft-tissue mass with fat attenuation due to invaginated mesentery was visible in the small bowel. This condition is sometimes referred to as the "bowel-within-bowel" appearance (10–13). Two cases of large-bowel intussusception were excluded from the study. One of the authors (N.L.) reviewed all available medical records and documented clinical and pathologic findings, including known diagnoses of gastrointestinal disease, malignancy, or metastases. Patient demographics, symptoms, indication for scanning, history of malignancy, and outcome were recorded. Indications for CT scanning were abdominal symptoms ( $n = 21$ ), surveillance of known or suspected tumor ( $n = 15$ ), and hematuria ( $n = 1$ ). Abdominal symptoms included pain, nausea, vomiting, or altered bowel habit. In patients with a history of malignancy, the presence or absence of known metastatic disease at the time of scanning was noted. Outcome was classified as either surgical or self-limiting, depending on whether the intussusception required surgical intervention or not. In patients who did not undergo surgery (ie, those with self-limiting cases), the results of clinical follow-up and any additional abdominal imaging studies were also documented.

### CT Technique and Interpretation

CT examinations were performed with spiral CT scanners ( $n = 24$ , LightSpeed, GE Medical Systems, Milwaukee, Wis;  $n = 13$ , CTi, GE Medical Systems). All patients received 800 mL of orally administered diatrizoate meglumine (Hypaque; Nycomed Amersham, Princeton, NJ). Thirty-six patients received 150 mL of intravenously administered iohexol (Omnipaque 350; Nycomed Amersham). Nine patients received 300 mL of rectally administered diatrizoate meglumine (Hypaque). CT examinations were performed with multiple phases of enhancement in 10 patients

(precontrast and postcontrast in nine and quadruple phase postcontrast in one). Section collimation was 5 mm ( $n = 21$ ), 7 mm ( $n = 12$ ), 2.5 mm ( $n = 3$ ), or 10 mm ( $n = 1$ ). All images were contiguous.

Two attending radiologists (R.S.B., F.V.C.) independently reviewed all CT scans on a picture archiving and communication system workstation (Impax; Agfa, Mortsel, Belgium). Readers were aware that the patients had a small-bowel intussusception, but they were unaware of all other clinical information. The length and maximum short-axis diameter of the intussusception were recorded. Intussusception length was measured along the long axis of the small bowel on contiguous sections. In patients in whom the intussusception was oriented in a cranio-caudal direction, length was calculated by observing the number of images on which the bowel-within-bowel appearance was evident. In patients in whom the intussusception was oriented horizontally, the length of the abnormal segment of bowel was measured directly. In patients in whom the intussusception was oriented obliquely, the length was measured by a combination of these techniques. Three-dimensional reconstruction or multiplanar reformatting was not used. Maximum short-axis diameter was measured as the largest distance between the outer aspects of the intussusception perpendicular to the long axis of the bowel. Visible lead-point disease, bowel obstruction, edema or infiltration adjacent to the intussusception, and ascites were also noted. A bowel obstruction was considered to be present if the small bowel proximal to the intussusception had a short-axis diameter greater than 3 cm.

### Data Analysis

Statistical calculations were performed by using a statistical software package (SAS 8.2; SAS Institute, Cary, NC). Descriptive statistics of means, standard deviations, and frequencies were used to describe patient characteristics. Reader agreement in intussusception length and diameter were evaluated in root mean squared errors and coefficients of variations. For purposes of analysis, bowel obstruction, edema or infiltration adjacent to the intussusception, and ascites were considered to be present if noted by either of the two readers. Association between categorical predictive variables and outcome were assessed with the Fisher exact test. Associations between continuous predictive variables and outcomes were assessed with odds ratios by

using logistic regression models. A multivariate, stepwise, logistic regression model was used to determine the best predictors of outcome. Close alternatives in logistic stepwise regression were analyzed as defined by Hauck and Miike (14). A significance level of 5% was used throughout.

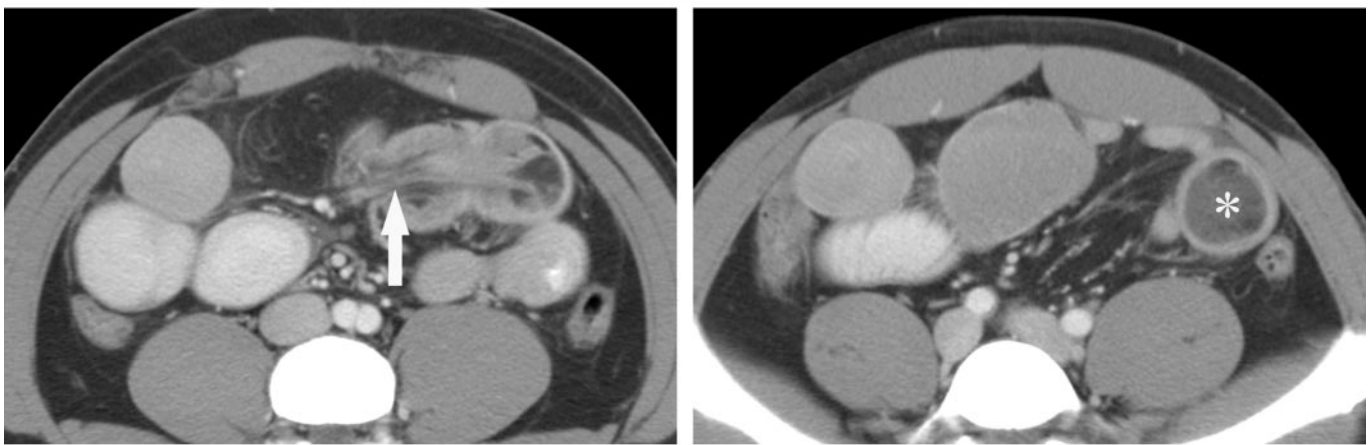
## RESULTS

### Outcome

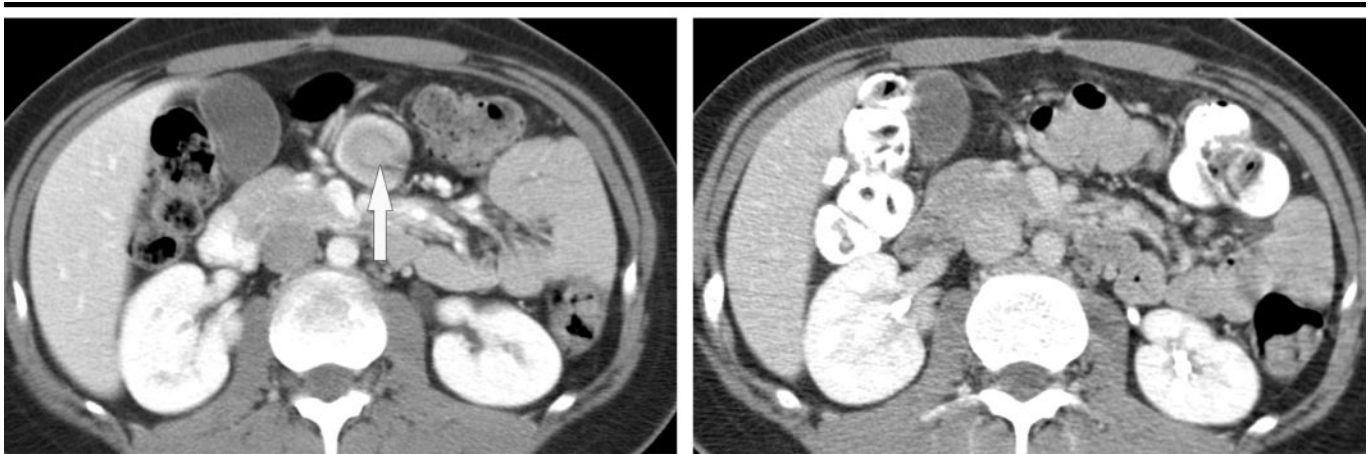
Six of the 37 patients underwent surgery (16%), and all had a lead-point tumor. The lead-point tumors were metastasis ( $n = 3$ ), lipoma ( $n = 1$ ; Fig 1), Burkitt lymphoma ( $n = 1$ ), and primary soft-tissue plasmacytoma ( $n = 1$ ). In the three patients with a metastatic lead point, the primary tumors were melanoma ( $n = 1$ ), colorectal adenocarcinoma ( $n = 1$ ), and renal cell carcinoma ( $n = 1$ ). Metastatic disease had been confirmed in all three of these patients prior to CT. None of the 37 patients in the study had intussusception as a metastatic manifestation of a previously undiagnosed malignancy. Both readers reported a visible lead-point mass in the patient with intussusception due to metastatic melanoma and in the patient with intussusception due to lipoma.

The remaining 31 patients were cared for conservatively and none underwent surgery. No follow-up information was available for six of these patients. The remaining 25 patients were observed for a median follow-up of 116 days (range, 1–1,389 days). Nine of the 31 patients had a known primary malignancy, and six of these patients had known metastases. Two other patients were known to have either celiac disease ( $n = 1$ ) or Crohn disease ( $n = 1$ ). All 10 of the CT examinations with multiple phases were performed in patients who had a self-limiting intussusception. Of note, the intussusception was persistent in six and transient in four of these 10 patients. In all four patients with transient intussusception, the intussusception was visible during early phases of imaging but not during delayed phases (Fig 2).

Twenty-five of the 31 patients (81%) with self-limiting intussusceptions received follow-up care at our institution. Twelve of these patients were followed clinically, and no relevant examinations were performed. Relevant examinations performed in the remaining 13 patients included small-bowel follow-through radiography ( $n = 6$ ), follow-up abdominal CT ( $n = 3$ ), enteroclysis ( $n = 2$ ), and upper gastrointestinal endoscopy ( $n = 2$ ). No small-bowel abnormality or intussus-



**Figure 1.** (a) Transverse contrast material–enhanced CT section in a 29-year-old man with nausea and vomiting due to a small-bowel intussusception shows the characteristic appearance of bowel within bowel (arrow). (b) Transverse contrast-enhanced CT section at a more inferior level than a shows a fatty mass (\*) at the head of the intussusception. Findings at surgery confirmed the presence of intussusception due to a lead-point lipoma.



**Figure 2.** (a) Transverse contrast-enhanced CT scan in a 49-year-old woman with vague abdominal pain shows a small-bowel intussusception (arrow). (b) Transverse contrast-enhanced CT scan obtained later during the same examination as a shows that the intussusception has spontaneously resolved. This finding is consistent with a transient and self-limiting small-bowel intussusception.

ception was identified on any of these images, with the exception of a small-bowel follow-through radiograph that demonstrated known Crohn disease of the terminal ileum, which was distal to the location of the intussusception identified at CT.

#### Distinguishing Features of Self-limiting Intussusception

Univariate analysis showed several significant differences between surgical and self-limiting cases (Table); however, multivariate, stepwise, logistic regression analysis showed that intussusception length was the only variable independently predictive of outcome (Fig 3), with an odds ratio of 1.57 (95% confidence interval: 1.17, 2.11). Known malignancy, age, and

the presence of infiltration, edema, or ascites were close alternatives. All 20 patients with an intussusception length of 3.5 cm or less as measured by either reader had self-limiting cases. Of the 17 patients with an intussusception length measured as greater than 3.5 cm by either reader, 11 had self-limiting cases and six underwent surgery. There was some interobserver variability in the measurement of intussusception length. Intussusception length measured by reader 1 was an average of 0.55 cm longer than intussusception length measured by reader 2 (95% confidence interval: 0.06 cm, 1.05 cm). The root mean squared error was 1.06 cm, and the corresponding coefficient of variation was 24%.

#### DISCUSSION

This study demonstrates that adult small-bowel intussusception is seen at only 0.05% of abdominopelvic CT examinations (37 of 69,040) performed at our institution. Our study may have overrepresented the frequency of adult small-bowel intussusception in the wider population of patients undergoing abdominopelvic CT, since our institution is an academic center that cares for a large number of patients with cancer and receives many tertiary referrals. Alternatively, our study may have underrepresented the frequency of small-bowel intussusception, since subtle unreported cases would not have been recognized in

the computerized search of our radiology information system that we used to identify patients for inclusion. Our results suggest that adult small-bowel intussusception detected with CT is frequently self-limiting; 31 of 37 (84%) small-bowel intussusceptions in our adult patients did not require surgery in our study. This conflicts with the traditional view of adult small-bowel intussusception as a condition that requires surgery. The explanation of this discordance is likely due to the detection of self-limiting subclinical cases of intussusception with CT (8,9,13,15). The fact that many cases of adult small-bowel intussusception that are detected with CT are self-limiting highlights the need for a reliable method of distinguishing surgical cases from those that can be safely managed conservatively. We found a number of significant differences between self-limiting and surgical cases, although multivariate, stepwise, logistic regression analysis showed intussusception length was the only variable that was independently predictive of outcome. All patients with an intussusception shorter than 3.5 cm as measured by either reader had self-limiting cases. A commonly expressed clinical concern is the possibility that adult small-bowel intussusception might be the initial manifestation of an occult disseminated malignancy; however, our study results suggest this is a very unlikely event. None of our patients had intussusception as a metastatic manifestation of a previously undiagnosed malignancy, and all three patients with metastatic intussusceptions had known metastatic disease elsewhere.

The results of our study correlate closely with those obtained in a smaller prior study of 29 small-bowel intussusceptions diagnosed at CT or magnetic resonance imaging (9). Only six of these patients (21%) were found to have lead-point tumors at surgery (three benign and three malignant). This is similar to our finding of lead-point tumors in six of 37 patients (16%). The neoplastic intussusceptions in this prior study had a mean length of 10.8 cm, while the mean length of the nonneoplastic intussusceptions was 4.0 cm. These numbers are similar to the mean intussusception length of 8.8 cm in our patients who underwent surgery and 4.4 cm in our patients with self-limiting cases. We cannot compare our results for interobserver variability or multivariate feature analysis with this prior study because such analyses were not presented. An earlier report describing self-limiting intussusception detected with CT did not describe measurements

### Comparison of Clinical and CT Features in Surgical and Self-limiting Cases of Intussusception

Features	Surgical Cases (n = 6)	Self-limiting Cases (n = 31)	P Value*
<b>Clinical</b>			
Mean age of patients (y)	50.0	39.3	<.05
No. of patients with gastrointestinal symptoms	3 (50)	18 (58)	NS
No. of patients with known malignancy	5 (83)	9 (29)	<.05
No. of patients with known metastases	3 (50)	6 (19)	<.05
<b>CT</b>			
Mean length of intussusception (cm)	8.8	4.4	<.01
Mean diameter of intussusception (cm)	3.7	3.0	<.05
No. of patients with dilated bowel proximally	5 (83)	7 (23)	<.01
No. of patients with infiltration, edema, or ascites	3 (50)	3 (10)	<.05

Note.—Numbers in parentheses are percentages.

\* P values for age, length, and diameters were derived from logistic regression model. P values for other variables were derived from Fisher exact test. NS = not significant.

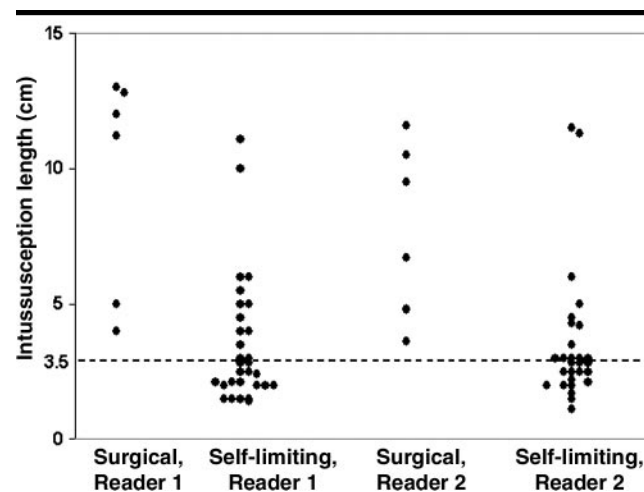


Figure 3. Length of intussusception in surgical and self-limiting cases, as measured by readers 1 and 2. All surgical cases of intussusception had a length greater than 3.5 cm, as measured by either reader.

of intussusception length and included only five patients (8).

Our study has several limitations. First, we lack pathologic correlation in the patients with self-limiting intussusceptions, and we cannot exclude the possibility that these patients had unrecognized lead-point abnormalities that might have been uncovered by a standardized and systematic evaluation; however, the fact that none of the patients required abdominal surgery or received a new diagnosis of malignancy over a median follow-up of 119 days suggests that this is unlikely. In addition, only 11 of the 31 patients with self-limiting intussusceptions had a history of malignancy ( $n = 9$ ), celiac disease ( $n = 1$ ), or Crohn disease ( $n = 1$ ) that might be associated with intussusception. While our results could be interpreted as suggesting that self-lim-

iting intussusceptions are probably idiopathic and nonneoplastic, it would be incorrect to directly equate these terms because of the absence of pathologic correlation. Second, since different surgeons cared for the patients and may not have employed uniform criteria when making the decision to perform surgery, it could be argued that some of the surgical cases might have been self-limiting if the natural history had been allowed to unfold. The low frequency of surgical intervention in this group of patients (six of 37) and the finding of a neoplastic lead point in all six patients who underwent surgery suggests this is unlikely and that rigorous and conservative criteria were being employed. Finally, the study was performed retrospectively at a single institution, and our results may not be applicable at other centers.

In conclusion, intussusception length is the main factor in distinguishing the majority of small-bowel intussusceptions detected with CT that are self-limiting from the minority that require surgery; an intussusception that is less than 3.5 cm in length is likely to be self-limiting.

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