Adult intestinal intussusception: can abdominal MDCT distinguish an intussusception caused by a lead point?

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Abstract

Background: Aim of our study was to assess the ability of computed tomography to distinguish between an intussusception with a lead-point from one without it.

Methods: Approval was granted by the Institutional Review Board. Ninety-three consecutive patients diagnosed with an intussusception on abdominal CT were classified with or without lead-point by surgery, clinical or radiological follow-up. Two radiologists blinded to the classification independently reviewed the CT images for predefined predictive variables.

Results: Non-lead-point intussusception was shorter in length (mean 4.9 vs. 11.1 cm for Reader 1 (R1); mean 4.0 vs. 8.9 cm for Reader 2 (R2), respectively, \( P < 0.001 \)), smaller in axial diameter (mean 3.0 vs. 4.8 cm for R1; mean 2.8 vs. 4.4 cm for R2, \( P < 0.001 \), respectively), less likely associated with obstruction (\( P = 0.002 \) R1; \( P = 0.039 \) R2) and infiltration (\( P < 0.001 \) for R1, \( P = 0.003 \) R2) than lead-point intussusception.

Conclusions: Abdominal CT is helpful in distinguishing between an intussusception with a lead-point from one without a lead-point. Length, axial diameter, and their product, as well as obstruction and infiltration, all suggest the presence of a lead-point. Analysis of CT findings can reduce unnecessary imaging follow-up or operation.

Key words: Computed tomography—Spiral-computed tomography—Multislice abdominal imaging—Small bowel disease—Large bowel disease

Intestinal intussusception in adults is rare (about 0.003%–0.02% of all hospital admissions) [1, 2]. It has traditionally been considered associated with an underlying cause in about 90% of cases [1–14]. However, the diagnosis was based on surgical results in patients who presented to the ED with obstructive symptoms [7, 12, 15]. With the increased use of CT, cases of transient intussusception, previously considered a finding typical only in children, are now diagnosed even in adults [9, 10, 16–21].

Currently, the diagnosis of intussusception is almost entirely based on CT, from the proved ability of radiologists to detect the typical bowel-within-bowel appearance [1, 2, 11, 14, 20, 22–28], but its etiology often remains obscure [2, 11].

Once an intussusception has been detected, the possibility of distinguishing a NLPI (non-lead point intussusception), which is more likely to spontaneously resolve, from a LPI (lead point intussusception), that is a serious condition likely to persist or recur without surgery, has become important [13, 14, 29, 30].

Our study aimed to assess the possibility of CT to distinguish a LPI from a NLPI. We sought to define distinguishing features that predict the presence of a lead-point.
Materials and methods

This retrospective single institutional study was approved by the Institutional Review Board. Informed patient consent was waived.

Demographics

A computerized search of all radiological reports of abdominopelvic CT in adults performed from January 1997, through December 2002, that contained the term “intussusception” in the text, was conducted. A radiologist (study organizer) reviewed reports, radiological and medical records, and the CT images, revealing 94 adult (93 patients > 18 years old; one patient 14 years old) patients with intussusception. The diagnosis of intussusception was determined by a bowel-within-bowel appearance on CT images. One patient with a tube induced intussusception was not considered further in this analysis. The remaining 93 patients (53 men, 40 women; age range 14–88 years; mean age 49 years) constituted the study population.

Medical records of these patients were reviewed. We found that patient symptoms that might have been intussusception-associated often were not described in a useful way. We were not able to reliably classify abdominal complaints, if any, as continuous or intermittent, acute or chronic.

The cases were correlated with results of surgery, subsequent imaging (CT, small bowel follow through), and clinical follow-up and, on the basis of the follow-up findings, classified as having or not having a lead-point; we included one patient with no follow-up information as the intussusception had a classic appearance agreed by two reviewers and the study organizer. By referring to the literature, the following were considered as being the lead-point of an identified intussusception: Meckel’s diverticula, metastases, lymphomas, adenocarcinomas and ingested foreign bodies cases; the following, instead, were considered no-lead-point intussusceptions: patients with surgical evidence of mesenteric vessel engorgement within intussusception, mesenteric vessel engorgement within intussusception, ascites, and intraabdominal neoplastic pathology.

Imaging protocols and data acquisition

All the exams had been performed on a 4-detector-row helical CT scanner (GE Lightspeed; GE Medical Systems, Milwaukee, WI, USA) with the following parameters: 120–140 kVp, 160 mAs, 0.8 s rotation-time, 4 x 2.5 mm collimation, pitch 6.5 mm, 4 mm slice thickness, no overlap. Intravenous injection at 3 mL/s of a total volume of 120 mL of 370 mgI/mL iopamidol (Isovue 370, Bracco Diagnostics, Princeton, NJ, USA) was performed in 91 patients; 88 patients received 300–1000 mL of dilute oral contrast material (Gastrografin, Bracco Diagnostics, Princeton, NJ). A scan delay of 60 s was empirically chosen for all the exams. The axial images were displayed using the radiology picture archiving and communication system (Impax 4.1; Agfa HealthCare, Ridgefield Park, NJ, USA).

Two board certified attending radiologists, each with 5 years experience with abdominal CT imaging interpretation, specialized in gastrointestinal radiology, blinded to the results, independently reviewed the CT images. They had to assess CT based clinical and pathological features. CT based clinical features included the overall assessment of intussusception by observation (0-absent; 4-present), the presence of mechanical obstruction resulting from intussusception [proximal dilatation (>3 cm) adjacent to intussusception with distal collapse or small bowel dilatation (>3 cm) related to the colocolic intussusception], the presence (and characteristics) of a visible lead mass separable from edematous bowel (0-no mass; 4-mass), a presumptive diagnosis of underlying pathology (0-non-neoplastic; 4-neoplastic), and how strongly clinical information provided suggested history of neoplasms. CT based pathological features were the site of intussusception (enteroenteric, ileocolic, colocolic), the overall size of intussusception measured by electronic caliper (length—measured by summation of consecutive images—and shortest axial diameter), the presence of peri- or perienteric infiltration adjacent to intussusception, mesenteric vessel engorgement within intussusception, ascites, and intraabdominal neoplastic pathology.

Statistical analysis

Interobserver agreement between the two readers was assessed using Cohen Kappa statistic. The correlation between the two readers was assessed using the Spearman’s rho and the Pearson correlation. Differences between the two readers were assessed by Wilcoxon signed rank test and t test. The relationships between categorical variables were evaluated using Fisher’s exact test. The predictive value of length, axial diameter and the combination of these two variables for predicting the presence of a lead-point was assessed by the Area Under the Receiving Operating Characteristic Curves (AUCROC).

All analyses were performed using the SPSS Statistical Software Package, version 14.0 (SPSS, Chicago, IL, USA).

Results

Outcome

Twenty (21.5%) of the 93 patients underwent surgery. A lead-point was found in 17.2% (16 of 93) patients; in 13 it was a malignant lesion, in two a Meckel’s diverticulum and in one a foreign body sited in the colon. The remaining four surgical patients were diagnosed with mesenteric adenopathy, liver laceration, small bowel volvulus, cholecystitis and no intussusception was present at surgery.
Of the 13 patients with a malignant lesion, three had metastatic disease [one lung carcinoma, two metastatic melanoma (one enteric and one colic) (Fig. 1)] and ten a primary bowel malignancy (small bowel adenocarcinoma \( n = 1 \); cecal adenocarcinoma \( n = 3 \); ascending colon adenocarcinoma \( n = 2 \); ascending colon lymphoma \( n = 1 \); descending colon adenocarcinoma \( n = 2 \) (Fig. 2); sigmoid colon cancer \( n = 1 \)). The site of malignant lesions was ileum (ileocolic) or colon (colocolic) in ten patients and small bowel (enteroenteric) in three patients (small bowel adenocarcinoma, lung, and one case of melanoma metastases).

Of the remaining 73 patients, 37 (39.7\% of 93) underwent radiological follow-up in the following three months. Eight patients were studied with small bowel follow through: one of these was found to have Crohn's disease, all the others had a negative exam. Twenty-nine patients underwent a follow-up CT with a negative result. Thirty-five patients (37.6\% of 93) had clinical follow-up with no further evidence of symptoms related to intussusception. One patient with no follow-up information was included as there was 100% agreement between CT report, both readers and the study organizer in considering this case as a NLPI. Therefore, on the basis of this information, 16 patients were classified as having LPI, and 77 patients were classified as NLPI.

**Imaging findings**

The confidence rate of intussusception by observation showed a fair agreement between the two readers (\( \kappa = 0.212 \)) that is statistically significant (\( P = 0.001 \)). The two readers were significantly correlated (\( \rho = 0.338 \)). Mechanical obstruction resulting from intussusception was seen in 11.8\% (11 of 93) of patients (Reader 1 (R1) and 9.7\% (9 of 93) of patients (Reader-2 (R2) (Figs. 1, 2)). A visible lead mass was found in 29\% (27 of 93) of patients by R1 with PPV = 37\% and NPV = 92.8\% for this study population, and in 20.4\% (19 of 93) of patients by R2 with PPV = 47.4\% and NPV = 91.2\% for this study population (Figs. 1, 2). The mean diameter of the lead mass was 2.7 cm for R1 [for whom 70.4\% of the masses (19 of 27) had irregular margins] and 2.3 cm for R2 [for whom 52.6\% (10 of 19) of lead masses had irregular margins]. A presumptive diagnosis of underlying neoplastic pathology was made in 36.6\% (34 of 93) and 15\% (14 of 93) of patients by R1 and R2, respectively. A strong suggestion of neoplastic process based on clinical information was found by R1 and R2, respectively in 25.8\% (24 of 93) and 3\% (3 of 93) of the patients.

The majority of intussusception was considered enteroenteric [78.5\% (73 of 93) R1; 72\% (67 of 93) R2] with just a few of them ileocolic [7.5\% (7 of 93) R1; 4.3\% (4 of 93) R2] or colocolic [4.3\% (4 of 93) R1; 6.5\% (6 of 93) R2] with a statistically significant (\( P < .001 \)) agreement between the two readers (\( \kappa = 0.478 \)). The median length of the intussuscepted segment was 6.10 ± 3.8 cm for R1 and 4.90 ± 2.8 cm for R2: their measurements were significantly correlated (\( r = 0.792 \)). The median axial diameter of the intussuscepted segment was 3.4 ± 1.0 cm for R1 and 3.1 ± 0.9 cm for R2. The correlation between the two readers was significant (\( r = .915 \)). Ancillary findings were detected in 77.4\% (72
of 93) of patients (R1) and 36.6% (34 of 93) of patients (R2) (Table 1).

### Features of LPI vs. NLPI

Statistical analysis showed several differences between cases diagnosed with a LPI and NLPI cases. The sensitivity, specificity, and overall accuracy for distinguishing a LPI \((n = 16)\) from a NLPI \((n = 77)\) were 71.4% (10 of 14), 75.4% (52 of 69) and 74.7% (62 of 83) for R1 \((P = 0.001)\); 69.2% (9 of 13), 84.1% (53 of 63) and 81.6% (62 of 76) for R2 \((P < 0.001)\), respectively. The interobserver agreement was good \((\kappa = 0.359)\); there was a suggestion of bias but it was not statistically significant \((P = 0.115)\).

Most of NLPI were considered, at CT images, enteroenteric \([88.3\% (68 of 77)\) R1; 79.2\% (61 of 77) R2\] \((\text{Figs. 3, 4})\), with a few of them ileocolic \(2.6\% (2 of 77)\) R1; 3.9\% (3 of 77) R2\) and none of them colocolic \(7 and 13 cases were considered no-intussusception by R1 and R2, respectively; between these, three were considered without intussusception by both readers: these cases were included because considered with intussusception by both the report and the study organizer). Both length and the shortest axial diameter of the intussuscepted segment were significantly correlated with the presence of a lead-point. NLPI was shorter in length \(\text{mean 4.97 vs. 11.11 cm for R1; mean 4.03 vs. 8.96 cm for R2, respectively,} P < 0.001\) and smaller in axial diameter \(\text{mean 3.06 vs. 4.8 cm for R1; mean 2.81 vs. 4.4 cm for R2,} P < 0.001, \text{respectively}\) than LPI (Table 2). Both readers had 100% of sensitivity in discriminating a LPI from a NLPI in measures £3.25 and £2.75 cm for length and diameter, respectively. The predictive values were 93.3% and 91.1% for length \(\text{respectively, R1 and R2}\) and 88.9% for both readers for axial diameter. Given that sensitivity and specificity are equally desirable, we weighted them the same (using their product) to find a cutpoint in length and axial diameter that simultaneously maximize them. The described cutpoints were 6.25 and 5.25 cm for R1, and 5.25 and 3.45 cm for R2 (length and axial diameter, respectively). We then tried to correlate the two variables measuring the AUC for the product of length and axial diameter and found a somewhat better predictive value \(94.1\% \text{ and 91.2}\% \text{ R1 and R2, respectively}\) using this variable than the length and the diameter considered separately.

### Table 1. Comparison of ancillary findings in presence or absence of a lead point

<table>
<thead>
<tr>
<th></th>
<th>R1</th>
<th>P value</th>
<th>R2</th>
<th>P value</th>
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<tbody>
<tr>
<td></td>
<td>Lead point ((n = 16))</td>
<td>No Lead point ((n = 77))</td>
<td></td>
<td>Lead point ((n = 16))</td>
</tr>
<tr>
<td>Pericolic or perienteric infiltration adjacent to intussusception</td>
<td>11 (68.8)</td>
<td>14 (18.2)</td>
<td>0.000</td>
<td>6 (37.5)</td>
</tr>
<tr>
<td>Mesenteric vessel engorgement within intussusception</td>
<td>13 (81.25)</td>
<td>55 (71.4)</td>
<td>0.287</td>
<td>10 (62.5)</td>
</tr>
<tr>
<td>Ascites</td>
<td>5 (31.25)</td>
<td>11 (14.3)</td>
<td>0.129</td>
<td>5 (31.25)</td>
</tr>
<tr>
<td>Intraabdominal pathology (e.g. peritoneal seeding)</td>
<td>3 (18.75)</td>
<td>7 (9.1)</td>
<td>0.359</td>
<td>5 (31.25)</td>
</tr>
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</table>

Data in parentheses are percentages

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**Fig. 2.** Colocolic intussusception secondary to a descending colon adenocarcinoma in a 31-year-old woman. Axial contrast-enhanced CT images of the lower abdomen demonstrate the presence of a lead point (black arrowhead in A) with accompanying mesenteric fat and vessels (A). Intussusceptum (black arrow in B) and intussucipiens (white arrows) are readily identifiable.
Identification of a mechanical obstruction resulting from intussusception was significantly correlated with the presence of a lead-point ($P = 0.002$ R1; $P = 0.039$ R2) (Figs. 1, 2). We found a statistically significant correlation for both readers between lead-point and pericolic or perienteric infiltration adjacent to intussusception ($P < 0.001$ R1, $P = 0.003$ R2). Regarding the other ancillary findings a significant correlation was detected for R2 but not for R1 (Table 1).

**Discussion**

Intussusception has been considered a disease typical of children, who often present with characteristic sudden onset of intermittent colicky pain, vomiting, and bloody mucoid stools [8, 12, 25]. In contradistinction, intussusception in adults has been reported to be rare (about 5% of all intussusceptions) [7, 12, 13], and is often accompanied by non-specific symptoms like intermittent abdominal pain and distension, and rarely presents as an acute condition [6, 8, 25]. In our study a mechanical obstruction was reported in about 10% of cases (11.8% R1, 9.7% R2).

However, while until the last few years, intussusception was diagnosed mainly in the operating room [1, 7, 8], the growing application of CT for abdominal imaging, in many clinical situations, has led to increased detection of transient intussusceptions without an underlying disease [8, 11, 13–15, 20, 28].

Most of the intussusception studies published until the mid-1990s are in the surgical literature [1, 3, 4, 8, 29, 31–33]. These and other more recent studies, report that 80–90% of intussusceptions in adults are secondary to a definable lesion [3, 4, 6, 8]. Moreover, they suggest that the majority of intussusceptions in adults tend to be colocolic in site and malignant in etiology [3, 7, 8, 12, 13, 33], with the enterenteric ones less frequent and usually caused by benign processes [24, 25]. In concordance with these studies we found that the majority of colic intussusceptions (either ileocolic or colocolic) were caused by malignant processes compared to a small percentage of small bowel cases [1, 8, 11, 14, 25]. Furthermore, small bowel intussusception is usually related to a benign condition and when related to a malignant process it is usually from metastatic disease, melanoma being the most common primary tumor (in our study two-thirds of small bowel tumor were metastases, one of them of a melanoma) [1, 6, 11, 14].

In 1999, Warshauer et al. [2], reported, in conflict with these earlier studies, that intussusception discovered in adults at CT or MRI imaging are predominantly enterenteric in type and are more often non-neoplastic in cause (although it is important to note that all the patients with a colocolic intussusception had a neoplastic lead-point). Our study, based on a significantly larger population (93 vs. 33 patients), further confirms these findings with a larger percentage of enterenteric vs. colocolic intussusceptions. This could be attributed, as suggested before, to the power of CT in diagnosing self-limiting intussusception and supports the hypothesis suggested by Warshauer et al. [2] that studies which needed a surgical confirmation were clearly biased towards lead-point lesions. In our study, 78.5% of the patient population avoided surgery; this percentage is comparable with the one of Lvoff et al. [15] (84% in a population of 37 patients with small bowel intussusception) and confirms the increased number of self-limiting intussusception now diagnosed. Transient intussuscep-
tion has been reported in adults with Crohn’s disease [17], celiac disease [11, 16, 29, 34] and malabsorption syndromes [9, 16] and is idiopathic in about 10% of cases [11]. We could find a cause for non-surgical intussusception in only one case that was diagnosed with Crohn’s disease at CT; we considered the other 72 cases idiopathic. Moreover, in our study, no clear cause of intussusception was noted in four patients who underwent surgery and they were classified as idiopathic too; these findings are comparable to those of Warshauer et al. [2] study that included five patients who underwent surgery with no evidence of intussusception found. Thus, in agreement with the results of other recent studies [15, 20], our study suggests that adult enterointestinal intussusception detected by CT is often transient and is unlikely to have a significant lead-point.

The ability of CT to demonstrate intussusceptions is well known [9, 14, 24, 25, 29], and findings like the presence of a bowel-within-bowel configuration with or without mesenteric fat and mesenteric vessels are pathognomonic of intussusception [14]. Despite this characteristic CT appearance, the etiology of intussusception usually remains difficult to establish [2, 11] and CT findings that help differentiate between LPI and NLPI have not been well studied. The increasing number of self-limiting cases of intussusception detected at CT emphasizes the need for a reliable method to distinguish transient intussusceptions from those which need prompt surgical intervention [2, 15]. In our study both readers had good sensitivity (71.4% Reader-1, 69.2% Reader-2) and specificity (75.4% R1, 84.1% R2) in distinguishing LPI and NLPI. Lvoff et al. [15] found that intussusception length was the only variable predicting outcome; Warshauer et al. [2] found that non-neoplastic intussusceptions were shorter, smaller in diameter and less likely associated with obstruction than those with a neoplastic lead-point. We found several variables significantly associated with the presence of a lead-point. NLPIs were significantly shorter in length and smaller in axial diameter, less likely associated with obstruction and pericolic or perienteric infiltration. Furthermore, the product of length and axial diameter was even more predictive than these two variables considered separately. This correlation will need further evaluation but could be promising in finding another variable predictive of a lead-point. All these findings suggest that adult enterointestinal intussusception detected by CT is often transient and is unlikely to have a significant lead-point.

Fig. 4. Axial abdominal contrast-enhanced CT scans at the level of the inferior pole of the kidneys obtained in a 38-year-old woman. Non-lead point small bowel intussusception characterized by a target-like (in A) and sausage-shaped (in B) mass. Intussusceptum (black arrow in A) and intussuscipiens (white arrow) are shown.

| Table 2. Comparison of length and axial diameter of intussusception in presence or absence of a lead point |
|-----------------|-----|-----|------------------|
| Lead point      | Mean| SD  | Std error mean   |
| Length (R1)     | No  | 4.97| 2.70             | 0.32 |
|                 | Yes | 11.11| 3.98            | 1.06 |
| Length (R2)     | No  | 4.03| 1.62             | 0.2  |
|                 | Yes | 8.96| 3.59             | 0.99 |
| Diameter (R1)   | No  | 3.05| 0.63             | 0.07 |
|                 | Yes | 4.8 | 1.17             | 0.31 |
| Diameter (R2)   | No  | 2.81| 0.62             | 0.07 |
|                 | Yes | 4.4 | 1.11             | 0.3  |
studies, [2, 9, 15, 17, 29] we believe that CT diagnosis is valid without surgical proof and is probably the best that can be achieved without performing surgery in patients that do not need it. A second limitation is that, although we considered a large population of patients, our study may have underestimated the frequency of intussusception since the selection of cases was done on the basis of radiological reports and some additional intussusceptions might have gone unobserved. Third, in the absence of surgical proof we cannot assume that none of the intussusceptions that we defined as NLPI type had an underlying small tumor. Fourth, we did not collect presenting symptoms, as described before, due to the difficulty in retrospectively characterizing symptoms based on clinical and radiological reports.

Although intussusception in adults is a relatively rare phenomenon, the number of cases detected at CT is increasing, most of these being NLPI. We found that CT is able not only to diagnose an intussusception but also to characterize it: radiologists could recognize a lead mass separable from edematous bowel in many cases of lead point intussusception (71.4% R1, 69.2% R2) and there was a strong correlation between presence of a lead-point and length and axial diameter of intussusception detected at CT images. Furthermore, mechanical obstruction and pericolic or perienteric infiltration are also valuable signs and evaluating the product of length and axial diameter appears to be especially helpful.

References