

CT Characteristics to Distinguish Between Non-Surgical and Surgical Adult Bowel Intussusceptions

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ABSTRACT

Objective: To distinguish between non-surgical and surgical adult bowel intussusceptions by using CT characteristics.

Methods: By searching from CT reports between January 2005 to December 2011, there were 76 patients with 82 lesions of adult bowel intussusceptions. CT scans were independently reviewed by two radiologists who were aware that all patients had an intussusception, but not given other clinical and pathological information. Accuracy of each CT characteristic to distinguish between non-surgical and surgical intussusception were calculated.

Results: There were 43 enteroenteric lesions (52.4%) and 39 colonic involving lesions (47.6%). Surgery was performed in 38 lesions (46.3%) and the remaining 44 lesions (53.7%) did not undergo surgery. Five of 43 (11.6%) enteroenteric and 33 of 39 (84.6%) colonic involving intussusceptions received surgery. Lead points were identified in all of the surgical intussusceptions. The mean sensitivity, specificity, positive predictive value, and negative predictive value to diagnose surgical enteroenteric intussusceptions using diameter thickness of > 4 cm, length > 4 cm, proximal bowel diameter > 3 cm, interposed fat thickness > 0.5 cm, and lead points were (100%, 92.1%, 62.5%, 100%); (100%, 47.4%, 20%, 100%); (40%, 94.7%, 50%, 92.3%); (80%, 73.7%, 28.6%, 96.6%) and (100%, 76.3%, 35.7%, 100%), respectively.

Conclusion: The majority of colonic involving intussusceptions undergo surgery. No CT feature is useful to diagnose surgical colonic involving intussusceptions. In contrast, most enteroenteric intussusceptions did not require surgery. Using diameter thickness > 4 cm, could be helpful to diagnose surgical enteroenteric lesions.

Keywords: Intussusception, bowel, gastrointestinal tract, adult, CT

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INTRODUCTION

Adult intussusception is relatively rare, and differs considerably from children intussusception in incidence, etiology, clinical presentation and treatment. It occurs in only 5% of all intussusceptions and about 1%-5% of

gut obstructions in adults.¹ Clinical diagnosis of adult intussusceptions still remains a challenge because of their non-specific symptoms. Although preoperative diagnosis can be made with many noninvasive imaging modalities including barium studies, ultrasound, CT and MR imaging, CT is now widely regarded as the modality of choice to diagnose intussusception in adults.

Prior studies¹⁻⁴ revealed that adult intussusception has an identifiable cause in up to 92% of cases. However, some studies^{5,6} showed that the detection of transient intussusception by CT

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has increased because of advances in CT scanners and increasing use of CT. Some CT characteristics such as identification of the lead point,^{7,8} presence of obstruction,⁸ features of vascular compromise,^{9,10} length⁵ and location¹¹ have been reported to be helpful to distinguish between non-surgical and surgical bowel intussusception. However, their clinical significance is still uncertain. The purpose of this study was to determine CT characteristics to distinguish between non-surgical and surgical bowel intussusceptions in adults.

MATERIALS AND METHODS

The presented retrospective study was approved by institutional review board and patient informed consent was waived. CT reports between January 2005 to December 2011 were searched by using “intuss” as a keyword in all reports from abdominal or abdomino-pelvic CT examinations performed on adults (18 years or older). The search results showed 76 patients (49 men and 27 women; a mean age of 51.54 years; age range, 19-87 years) diagnosed as intussusception by CT scan.

CT techniques

Seventy-three CT examinations were performed by 64-MDCT scanners (Somatom Definition, Siemens AG, Germany, or LightSpeed VCT, GE healthcare, Milwaukee, WI, USA) and the remaining three CT examinations were performed by a single-slice helical CT scanner (Tomoscan AV1, Philips medical systems). CT image thickness ranged from 1.25 to 1.5 mm, for MDCT scanners and 10 mm, thickness for helical CT scanner. All CT examinations were performed with the administration of IV contrast medium. Oral and rectal contrast were administered in some selected patients that were indicated in the CT protocol. CT examinations were performed with only IV contrast material in 9 patients, with IV and oral contrast material in 37 patients, and with all IV, oral and rectal contrast material in 30 patients. Contrast-enhanced scans were performed during the arterial and portal venous phases (35-40 seconds for arterial, 80 seconds for portal venous after the IV contrast injection).

Image Interpretation

Intussusception was defined if a bowel-within-bowel configuration with or without invaginating mesenteric fat and vessels was noted. CT scans were independently reviewed on a picture archiving and communication system workstation by two radiologists with 9 and 11 years of abdominal radiology experience. Both readers were aware that all included patients had an intussusception, but they were blinded from clinical information, the number and location of intussusception, follow-up studies, treatment outcome and final diagnosis. All CT examinations, except three examinations performed with helical CT scanner, were reviewed on all axial, coronal and sagittal reformatted images. Two readers collected data including number, types (enteroenteric, enterocolic, colocolic), and detection (present, absent, or indeterminate) of lead points. If a lead point was identified, presence of fat density and enhancement pattern (homogenous, heterogenous) were obtained. Measurement of the maximum length of the intussusception, the maximal diameter of intussusception, the maximum thickness of any visualized interposed fat, and the maximum diameter of the normal bowel just proximal to the intussusception were performed. If measurement of two readers was significantly different, the measurement was repeated with a consensus review. If the intussusceptions were only seen on some phase images of examination and/or any follow up imaging studies showed disappearance of the lesions, they were classified into transient intussusception.

Clinical data

Medical records were reviewed by a 3rd year resident in radiology to obtain demographic data, clinical presentation, patient outcome including whether surgery was performed for treatment, and final diagnosis. In surgical lesions, surgical indication, pathological reports, and surgical findings were obtained to determine cause of intussusception. In non-surgical lesions, results of follow-up imaging studies which included abdominal CT examinations in 16 lesions, small-bowel barium study in 3 lesions, and clinical follow-up in 25 lesions, were obtained.

Data analysis

Statistical analysis was performed by using descriptive statistics to determine mean, range and frequency. Agreement between two readers was assessed using intraclass correlation coefficient (ICC). CT characteristics helpful in distinguishing surgical from non-surgical intussusceptions were determined using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

RESULTS

Seventy-six patients were determined at CT as having one ($n = 71$), two ($n = 4$; 3 cases were lymphoma and one case was Peutz-Jeghers syndrome) and three ($n = 1$, metastatic carcinoma) intussusceptions. Surgery was performed in 37 patients (38 lesions). The remaining 39 patients (44 lesions) did not undergo surgery. In surgical lesions (37 patients), clinical presentations were abdominal pain ($n = 14$, 37.8%), mucous bloody stool ($n = 12$, 32.4%), bowel habit change ($n = 8$, 21.6 %) and asymptomatic ($n = 3$, 8.1 %). Surgical indications were clinical gut obstruction (11 patients) and malignancies (26 patients). Surgical interventions were performed at a mean of 44 days (range, 0 - 169 days) from the time of the CT examination. In non-surgical lesions (39 patients), clinical presentations were asymptomatic ($n = 23$, 59%), abdominal pain ($n = 7$, 18%), bowel habit change ($n = 4$, 10.2%), abdominal mass ($n = 3$, 7.7%), and mucous bloody stool ($n = 2$, 5.1%).

There were 20 transient intussusceptions. Five lesions had a lead point due to lymphoma and disappeared after chemotherapy on follow-up imaging studies. In the remaining 15 lesions, no lead points were identified.

Type and quantitative measurements of intussusceptions

The total of 82 lesions were classified as enteroenteric (43 lesions, 52.4%), enterocolic (15 lesions, 18.3%), and colocolic (24 lesions, 29.3%) intussusceptions. There was no disagreement on the types of all intussusceptions between both readers. Enterocolic and colocolic lesions were combined into a colonic involving intussusception group (39 lesions).

Of 38 surgical lesions, 5 lesions were enteroenteric and 33 lesions were colonic involving intussusceptions. The mean of the maximum length, the maximum diameter, the maximum interposed fat thickness, and the maximum proximal bowel diameter of both readers were 9.2 cm. \pm 4.7 SD, 5.0 cm. \pm 1.0 SD, 0.9 cm. \pm 0.8 SD and 3.0 cm. \pm 1.5 SD, respectively.

Of 44 non-surgical lesions, 38 lesions were enteroenteric and 6 lesions were colonic involving intussusceptions. The mean of the maximum length, the maximum diameter, the maximum interposed fat thickness, and the maximum proximal bowel diameter of both readers were 4.8 cm. \pm 3.1 SD, 3.2 cm. \pm 1.2 SD, 0.5 cm. \pm 0.5 SD and 1.7 cm. \pm 0.9 SD, respectively.

The intraclass correlation coefficient (ICC) of intussusception length, diameter, interposed fat thickness and proximal bowel diameter were 1.0, 0.998, 0.999 and 0.996, respectively.

Lead points

CT could identify lead points in all surgical intussusceptions which showed heterogeneous enhancement for 34 lesions, homogenous enhancement for 2 lesions, and fat density for 2 lesions. There were 28 malignant lead points [colon cancer ($n = 25$), lymphoma ($n = 2$), metastatic osteosarcoma ($n = 1$)] and 10 benign lead points [hamartomatous polyps ($n = 3$), low-grade adenoma ($n = 2$), lipoma ($n = 2$), inflammatory fibroid polyp ($n = 1$), leiomyoma ($n = 1$), TB ($n = 1$)].

Of 44 non-surgical intussusceptions, lead points were identified on CT in 15 lesions which shown heterogeneous enhancement for 5 lesions, homogenous enhancement for 9 lesions, and fat density for 1 lesion. Nine lesions were detected in enteroenteric intussusceptions [one lesion was lipoma and other cases had underlying history of lymphoma ($n = 6$), metastatic carcinoma ($n = 1$) and somatostatinoma ($n = 1$)] and remaining 6 lesions (all lymphomas) were visualized in colonic involving intussusceptions. Follow-up results of 29 patients who did not have a lead point showed clinical improvement in 28 patients. The only one patient diagnosed as lymphoma still had clinical symptoms of intussusception.

Accuracy of CT characteristics to diagnosed surgical intussusceptions

The sensitivity, specificity, PPV and NPV of CT characteristics to diagnosed surgical enteroenteric and colonic involving intussusceptions were shown in Table 1.

For enteroenteric intussusception, the authors used the maximum length > 4 cm. which had sensitivity 100%, specificity 47.4%, PPV 20% and NPV 100%. Maximum diameter > 4 cm. had sensitivity 100% and NPV 100%. However, 3 of 38 nonsurgical enteroenteric intussusceptions also had diameter > 4 cm, resulting a high specificity (92.1%) and moderate PPV (62.5%). Similarly, presence of a lead point gave sensitivity 100% and NPV 100%. However, 9 nonsurgical enteroenteric intussusceptions also had a lead point, resulting a moderate specificity (76.3%) and poor PPV (35.7%). Proximal bowel diameter > 3 cm, had high specificity (94.7%) and high NPV (92.3%), but had poor sensitivity (40%) and poor PPV (50%).

For colonic involving intussusceptions, all surgical lesions had a lead point (sensitivity 100%). However, 6 nonsurgical lesions also had a lead point (all lymphoma) resulting in PPV 84.6%.

DISCUSSION

Currently, there is no universal approach about the treatment of adult intussusceptions, although treatment usually requires resection of the involved bowel segment because of underlying malignant neoplasm and risk of ischemia. However, studies of adult intussusceptions detected by imaging showed increased number of transient enteroenteric intussusceptions which do not require surgery.^{5,6} In the present study, only 11.6% of enteroenteric intussusceptions underwent surgery. Results were similar to prior studies^{5,8,12} that majority of adult small bowel intussusceptions detected by imaging tend to be nonsurgical lesions.

Unlike prior studies^{6,8,12} which showed predominately (about 88-90%) enteroenteric intussusceptions detected by imaging, our study found slightly more common enteroenteric type (52.4%) than colonic involving type (47.6%), similar to results with some prior surgical series.^{3,4,13,14} This could be because our institution is a tertiary medical center that cares for a large number of cancer patients.

For enteroenteric intussusceptions, results

TABLE 1. Accuracy of CT characteristics to diagnose surgical intussusceptions.

CT characteristics	Sensitivity % (No.)	Specificity % (No.)	PPV % (No.)	NPV % (No.)
Enteroenteric intussusceptions				
Length (>4 cm.)	100 (5/5)	47.4 (18/38)	20 (5/25)	100 (18/18)
Diameter thickness (>4 cm.)	100 (5/5)	92.1 (35/38)	62.5 (5/8)	100 (35/35)
Proximal bowel diameter (>3 cm.)	40 (2/5)	94.7 (36/38)	50 (2/4)	92.3 (36/39)
Interposed fat thickness (>0.5 cm.)	80 (4/5)	73.7 (28/38)	28.6 (4/14)	96.6 (28/29)
Lead point	100 (5/5)	76.3 (29/38)	35.7 (5/14)	100 (29/29)
Colonic involving intussusceptions				
Length (>6 cm.)	60.6 (20/33)	33.3 (2/6)	83.3 (20/24)	13.3 (2/15)
Diameter thickness (>4.5 cm.)	69.7 (23/33)	33.3 (2/6)	85.2 (23/27)	16.7 (2/12)
Proximal bowel diameter (>4 cm.)	15.2 (5/33)	100 (6/6)	100 (5/5)	17.6 (6/34)
Interposed fat thickness (>1 cm.)	33.3 (11/33)	66.7 (4/6)	84.6 (11/13)	15.4 (4/26)
Lead point	100 (33/33)	0 (0/6)	84.6 (33/39)	0 (0/0)

PPV = positive predictive value, NPV = negative predictive value

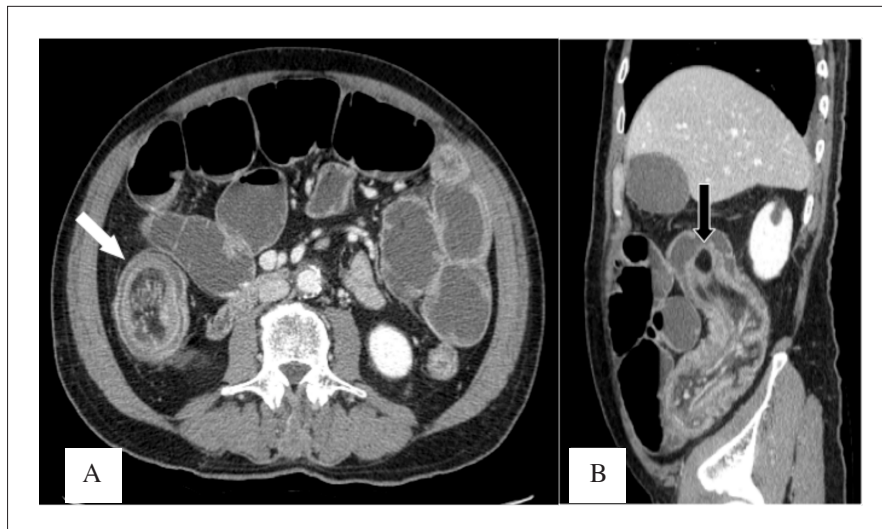


Fig 1. A: Axial contrast enhanced CT abdomen showed target sign (white arrow). **B:** Sagittal reconstruction images showed enteroocolic intussusception with lipoma as a benign lead point (black arrow).

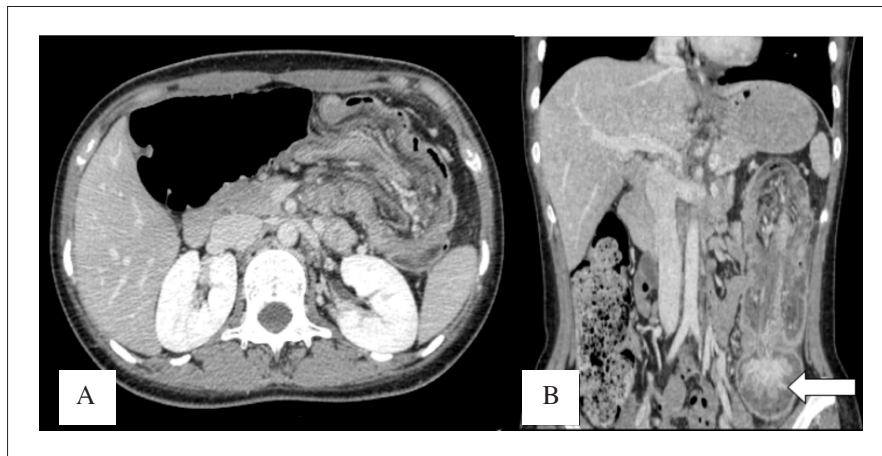


Fig 2. A: Axial contrast enhanced CT abdomen showed colocolic intussusception with marked proximal bowel dilatation. **B:** Coronal reconstructed image showed long segment of colocolic intussusception with malignant lead point produced by metastasis osteosarcoma (arrow).



Fig 3. Transient intussusception. Axial (A) and coronal (B) post-contrast CT image showed enteroenteric intussusception (arrow) without a lead mass. No identifiable intussusception on pre-contrast image (not shown).

of the present study showed that maximum diameter > 4 cm. was a helpful quantitative measurement to diagnose surgical lesions and all lesions that had diameter ≤ 4 cm. were non-surgical lesions (sensitivity 100, NPV 100%). However, use of this parameter alone to indicate surgical treatment should be careful because 3 of 38 non-surgical lesions also had diameter more than this cutoff value too. Cutoff value > 4 cm. in this study was different from a prior study⁸ that used diameter > 3 cm. If the diameter > 3 cm. was used in our study, the sensitivity, specificity, PPV and NPV would be 100%, 68.4%, 29.4% and 100%, respectively. All enteroenteric intussusceptions with diameter ≤ 3 cm, also were non-surgical lesions in the present study. The cutoff value of maximum length was also different from prior studies.^{5,8} If the maximum length > 3.5 cm, was used, the sensitivity, specificity, PPV and NPV would be 100%, 42.1%, 18.5% and 100%, respectively. Lvoff⁵ found that an intussusception length < 3.5 cm, is likely to be self-limiting. Similar with Sundaram study,¹² our results showed that nearly half of non-surgical lesions also had length greater than the cutoff value.

In contrast to enteroenteric type, the present study found approximately 85% (33/39) of colonic involving intussusceptions underwent surgery and the majority of cases had underlying malignancy of which colon cancer was the most common cause. The authors agree with the study by Sundaram¹² that no quantitative measurement is useful for distinguishing between surgical and non-surgical colonic involving intussusceptions, and type of intussusception involving colon is a good predictor for high likely indication for surgical treatment.

In the present study, 32.5% (14/43) of enteroenteric intussusceptions and 100% of colonic involving intussusceptions had a lead point. Except 6 lesions with lead point due to lymphoma which were treated with chemotherapy, all colonic involving type with presence of a lead mass were treated with surgery. Our results showed that enteroenteric intussusception without a lead point was likely to be a non-surgical lesion, but those with a lead point could be either surgical lesion or non-surgical lesion. However,

distinguishing a lead mass from edematous bowel of intussusception is difficult⁷ and distinguishing a malignant from benign neoplasm is not reliable on CT, except a lipoma which contains fat density.¹⁵ Tresoldi et al, found that intussusception without a lead point tended to be shorter in length and smaller in diameter than intussusception with a lead point, and less likely associated with obstruction and infiltration.¹⁶ Intussusception with either benign or malignant lead point can be transient.¹⁷

The present study had some limitations. This study was a retrospective design at a single institution. There is no universal guideline for treatment of adult intussusceptions, so determination of surgical lesions depends on each surgeon and varies in each institution. Some nonsurgical lesions did not have long term follow-up imaging studies or clinical information. Finally, this study did not assess vascular compromise or bowel strangulation which could indicate emergency surgery.

CONCLUSION

Adult intussusceptions detected by CT are not always treated surgically. The majority of colonic involving intussusceptions require surgery, while the majority of enteroenteric type do not undergo surgery. Enteroenteric intussusceptions that had diameter > 4 cm. tend to be a surgical lesion. On the other hand, no measurement can be used to distinguish surgical colonic involving lesion from nonsurgical colonic involving lesions.

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