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## **Ileoileal intussusception in children: Ultrasonographic differentiation from ileocolic intussusception.**

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## Abstract

### Introduction:

The treatment of ileoileal intussusception in children differs from that of ileocolic intussusception. The purpose of this study was to identify ultrasonographic differences between ileoileal intussusception and ileocolic intussusception.

### Materials and methods:

We reviewed the clinical and ultrasonographic findings in 27 cases of intussusception between September 2003 and July 2005. For statistical analysis the Mann-Whitney test was applied.

### Results:

Regarding ileoileal intussusceptions, 11 were documented in ten patients (7 boys, 3 girls; mean age, 3.1 years). Symptoms suggestive of intussusception were present in nine patients. Mean diameter was 1.5 cm (range, 1.1-2.5 cm) and length 2.5 cm (range, 1.5-6.0 cm). The intussusceptions were located in the paraumbilical region ( $n = 6$ ), the right upper quadrant ( $n = 2$ ), the right lower quadrant ( $n = 2$ ) and the left lower quadrant ( $n = 1$ ).

Regarding ileocolic intussusceptions, 16 were documented in 14 patients (13 boys, 1 girl; mean age, 1.9 years). All patients had symptoms suggestive of intussusception. The mean diameter was 3.7 cm (range, 3.0-5.5 cm) and mean length was 8.2 cm (range, 5.0-12.5 cm). All intussusceptions were located in the right side of the abdomen. The difference in diameter and length between ileoileal and ileocolic intussusception was statistically significant ( $p < 0.05$ ).

### Conclusion:

When the diameter is more than 2.5 cm and the length is more than 5.0 cm, the intussusception is most likely to be ileocolic.

## **Introduction**

Intussusception is diagnosed by ultrasonography (US) in a quick, simple and non-invasive way with a high sensitivity (98%-100%) and specificity (88%-100%) [1, 2]. The components of an intussusception produce characteristic appearances on US images. According to the literature, in the majority of pediatric cases the intussusception is located in the ileocolic part of the bowel. However, a small percentage of the intussusceptions are located in the small bowel [1-4].

The treatment of ileocolic and ileoileal intussusceptions is different. The first type of intussusception requires invasive treatment: enema and in some cases surgery. In contrast, in ileoileal intussusception a 'wait-and-see' policy is considered appropriate in patients without an indication for surgery such as peritonitis or ileus. It is therefore necessary to differentiate between ileocolic and ileoileal intussusceptions. There are several reports concerning the typical ultrasonographic appearances of intussusceptions, for example the doughnut or sandwich signs [1, 5]. However, less is known about the ultrasonographic differentiation between ileoileal and ileocolic intussusception using criteria such as mean diameter, length and blood flow of the intussusception. Therefore, we describe and compare the ultrasonographic features of both ileoileal and ileocolic intussusceptions.

## **Materials and methods**

### *Patients*

We retrospectively reviewed the clinical records and US imaging findings of all children in whom an ileocolic or an ileoileal intussusception was diagnosed by US between September 2003 and July 2005. A total of 24 children with 27 intussusceptions were included in our study. We divided the study population into two groups. Group 1 included all patients with an ileoileal intussusception that persisted throughout the ultrasonographic examination. This group comprised seven boys and three girls with a mean age of 3.1 years (range, 8 months to 4 years). Group 2 included 14 patients (13 boys and 1 girl; mean age, 1.9 years; range, 1 month to 7 years) with an ileocolic intussusception. Transient (i.e. existing for only seconds or minutes) ileoileal intussusceptions during sonographic examination were excluded. The durations of the examinations ranged from 15 to 30 min.

We reviewed the age, clinical findings at presentation and medical history for known conditions associated with intussusception. Symptoms suggestive of an intussusception were abdominal pain, palpable mass, vomiting and/or rectal bleeding. Recurrence of the intussusception was documented, as was the need for surgery and the final outcome. Institutional review board approval was obtained for our study.

### *Ultrasonography*

All patients underwent an abdominal US scan. The ultrasonographic examination included routine evaluation of the entire abdomen (liver, gallbladder, pancreas, spleen, kidneys, bladder and bowel). The graded compression technique following the method of Puylaert [6] was used to depict the intussusception. The examinations were carried out by a pediatric radiologist (H.C.H.) and a staff radiologist using a 2-5 curved-array transducer and a 7-12 MHz linear-array transducer (ATL HDI 5000, Philips Medical Systems). The pediatric radiologist had at the start of the study period 12 years of experience in pediatric abdominal US. The staff radiologists had a mean specific experience in pediatric abdominal US of 10 years. We considered intussusceptions to be in the small bowel (a) because of their diameter (ileoileal intussusceptions are smaller than ileocolic intussusceptions), (b) because of their length (ileoileal intussusceptions are shorter than ileocolic intussusceptions) and (c) from the location (ileoileal intussusceptions are located mostly in the paraumbilical region and sometimes in the left upper quadrant, right upper quadrant or lower quadrant).

The location of the intussusception was documented (paraumbilical region, left or right lower or upper quadrant of the abdomen), and the diameter and length of the intussusception were measured. The diameters were measured by placing electronic calipers on the outer border of the outer hypoechoic rim. We determined if there was blood flow in the intussusception with color Doppler US. A lead point, if present, was noted. The presence of mesenteric lymph nodes in the intussusception or in the surrounding area was noted. All children were reexamined with US after several hours (when there were continuing symptoms or signs) or the next day.

### *Statistical analysis*

For the comparison of the diameter and length (both non-normally distributed) of ileoileal and ileocolic intussusceptions the Mann-Whitney test was applied. *P* values of less than 0.05 were considered to indicate statistically significant differences.

## **Results**

### *Clinical symptoms*

In the first group (ileoileal intussusception), nine patients presented with one or more symptoms suggestive of intussusception (abdominal pain  $n = 6$ , palpable abdominal mass  $n = 1$ , vomiting  $n = 3$ , and rectal bleeding  $n = 2$ ). One patient had a predisposing medical history of cystic fibrosis. The final clinical diagnoses included gastrointestinal infection ( $n = 5$ ), cystic fibrosis ( $n = 1$ ), Burkitt lymphoma ( $n = 1$ ) and idiopathic intussusception ( $n = 4$ ). One patient had a recurrent ileoileal intussusception. Only the patient with Burkitt lymphoma required surgery because of the large mass and additional ileus.

In the second group (ileocolic intussusception), all patients had one or more symptoms suggestive of intussusception (abdominal pain  $n = 10$ , palpable abdominal mass  $n = 1$ , vomiting  $n = 4$ , and rectal bleeding  $n = 3$ ). There were no predisposing medical histories. In 12 patients the ileocolic intussusception was successfully reduced with a hydrostatic enema. Two patients had a recurrence of ileocolic intussusception. In total, four patients needed surgery. Two patients were operated on immediately because of absence of blood flow in the intussuscepted bowel wall on color Doppler US. Two other patients required surgery; one because of irreducibility with hydrostatic enema and the other patient because of recurrence of the intussusception shortly after the first intussusception and suspicion of a lead point.

#### *Ultrasonographic features of ileoileal intussusception*

Results of the US features of ileoileal and ileocolic intussusceptions are summarized in Table 1. The ileoileal intussusceptions were located in the paraumbilical region ( $n = 6$ ), the right upper quadrant ( $n = 2$ ), the right lower quadrant ( $n = 2$ ) and the left lower quadrant of the abdomen ( $n = 1$ ). The mean diameter was 1.5 cm (range, 1.1-2.5 cm) and mean length was 2.5 cm (range, 1.5-6.0 cm). The shortest bowel segment involved in the ileoileal intussusceptions measured only 1.5 cm. The longest ileoileal intussusception measured 6 cm. Blood flow in the intussuscepted bowel wall was present in all ileoileal intussusceptions. Classic US imaging signs of ileoileal intussusception are depicted in Figure 1.

Only one lead point was depicted on US: an enlarged mesenteric lymph node with a short axis diameter of 3 cm in the mesentery in close approximation to the intussusception. Pathologic diagnosis of this lymphoid tissue was Burkitt lymphoma. Nine patients had several lymph nodes spread throughout the mesentery with a mean short axis diameter of 7.4 mm (range, 5.0-10.0 mm). Follow-up US in all patients, several hours to one or more days after the first US examination, showed no recurrence of intussusception.

#### *Ultrasonographic features of ileocolic intussusception*

All ileocolic intussusceptions were located in the right side of the abdomen. One ileocolic intussusception extended to the left lower quadrant, this intussusception had the greatest length (12.5 cm). Mean diameter was 3.7 cm (range, 3.0-5.5 cm) and mean length was 8.2 cm (range, 5.0-12.5 cm). The intussuscepted bowel wall showed no blood flow by color Doppler US in two patients. These patients were operated on immediately. During surgery, necrotic bowel wall was found in those patients without blood flow in the intussusception on color Doppler US. Mesenteric lymph nodes with a short axis diameter of  $\leq 5$  mm were seen in the intussusception in 14 patients with an ileocolic intussusception. No other lead points were depicted on US. Figure 2 shows an ileocolic intussusception in the axial and longitudinal planes.

One intussusception was wrongly documented as ileocolic at presentation. On enema there was no ileocolic intussusception and during review of the US images the findings were reinterpreted as an ileoileal intussusception. This had resolved spontaneously by the time of the follow-up

US scan. This misdiagnosis was caused by thickening of the cecal and terminal ileal wall as a consequence of infection with *Campylobacter*. This patient was included in the first group.

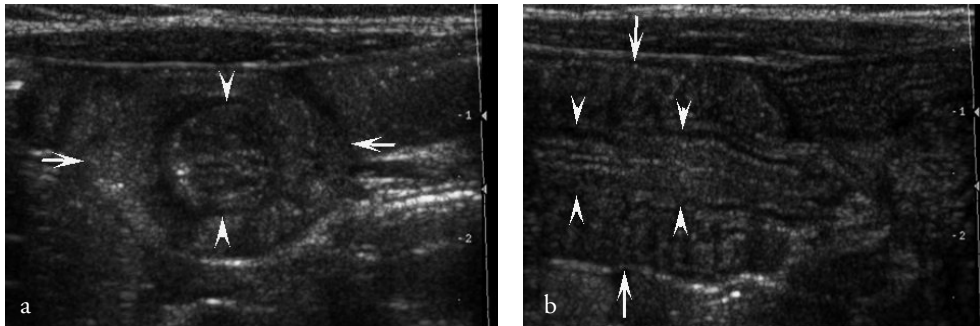
### Statistical analysis

The Mann-Whitney test revealed statistically significant differences ( $p < 0.05$ ) in diameter and length between ileoileal and ileocolic intussusceptions.

**Table 1** Ultrasonographic appearance of ileoileal and ileocolic intussusception

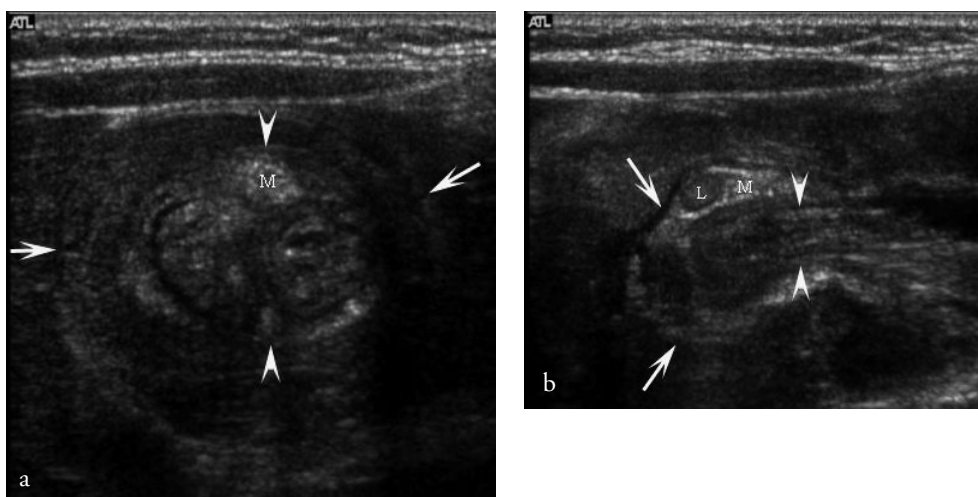
	Ileoileal intussusception ( $n = 11$ )	Ileocolic intussusception ( $n = 16$ )
Location ( $n$ ):		
para-umbilical	6	0
right lower or upper quadrant	4	16
left lower quadrant	1	1 <sup>a</sup>
Mean diameter (cm)	1.5	3.7
Mean length (cm)	2.5	8.2
Blood flow present ( $n$ )	11	14
Lead point in intussusception ( $n$ )	0	14

<sup>a</sup> One ileocolic intussusception extended to the left lower quadrant; this intussusception had the greatest length (12.5 cm)



**Figure 1.**

Ileoileal intussusception. Axial (a) and longitudinal (b) US scans show the typical crescent-in-doughnut sign (a) and hay-fork sign (b).



**Figure 2.**

Ileocolic intussusception. Axial (a) and longitudinal (b) US scans (arrowheads intussuscepted ileum, white arrows colon wall, *L* lymph node within the intussusception, *M* mesenteric fat within the intussusception).

## Discussion

In this study we determined the US imaging features of ileoileal intussusception in children and differentiated these from those of ileocolic intussusception. The mean age at presentation of patients with ileoileal intussusception was 3.1 years and of patients with ileocolic intussusception was 1.9 years. Ileoileal intussusception is more common in neonates and older children (>5 years old). The age at presentation of the patient plays an important role in differentiating type and pathology of the intussusception. Small bowel intussusceptions are more common in older patients and the ileoileal location is a frequent finding in intussusception in adults [3]. The mean age of children with small bowel intussusception ranged from 4 to 11 years in several studies [3, 4, 7, 8]. Idiopathic intussusception is more common in children between 6 months and 2 years of age [1]. The percentage of intussusceptions due to a lead point, other than normal small mesenteric lymph nodes, increases with age, from 5% in children aged 0-11 months to 60% in those aged 5-14 years. Intussusceptions in neonates and older children are more likely to have a lead point. However, the incidence of lead points before 5 years of age is still high because more intussusceptions occur below 5 years of age [9].

The findings concerning clinical symptoms in our study showed that ileoileal and ileocolic intussusceptions could not be differentiated on the basis of clinical presentation. The vast majority of ileoileal and ileocolic intussusceptions presented with nonspecific symptoms such as vomiting and abdominal pain. Even the classic current jelly bloody stool was equally distributed in both groups: 18% ( $n = 2$ ) of the 11 ileoileal and 19% ( $n = 3$ ) of the 16 ileocolic intussusceptions.



Of the patients with ileoileal intussusception, 90% were symptomatic (i.e. they had abdominal complaints). However, Kornecki et al. [8] found that 65% of the small bowel intussusceptions were in asymptomatic children. An explanation for this difference might be that Kornecki et al. included all patients with small bowel intussusceptions, even those that come and go during ultrasonographic examination (transient intussusceptions). The latter intussusceptions were not included in our study. Transient (i.e. existing for only several seconds or minutes) ileoileal intussusceptions are commonly seen in our institution. These intussusceptions are usually recorded as an incidental finding.

The location of the ileoileal intussusception differed from that of the ileocolic intussusceptions. The ileocolic intussusceptions were located in the right upper or lower quadrant of the abdomen; the ileoileal intussusceptions were located mostly in the paraumbilical region. This finding is similar to the findings of Ko et al. [4] and Kornecki et al. [8].

There are fewer reports of the diameter of small bowel intussusceptions determined by US. Ko et al. [4] state that the mean diameter of small bowel intussusceptions is 2.9 cm. However, we found a much smaller mean diameter (1.5 cm) of ileoileal intussusceptions. The widest intussusception in our series had a diameter of 2.5 cm. Our findings agree with the results (mean diameter 1.5 cm) of Kim [10]. Strouse et al. [7] found a mean short-axis diameter of 2.1 cm (range, 1.5-3.0 cm) for small bowel intussusceptions identified on CT. In our study the mean short-axis diameter of the ileocolic intussusceptions was 3.7 cm. There was a statistically significant difference in short-axis diameter between ileoileal and ileocolic intussusception, although the subpopulations were small (group 1,  $n = 11$ ; group 2,  $n = 16$ ).

According to previous studies ileoileal intussusceptions tend to be shorter than ileocolic intussusceptions [7, 8]. In our study the mean lengths of the ileoileal and ileocolic intussusceptions were 2.5 cm (range, 1.5-6.0 cm) and 8.2 cm (range, 5.0-12.5 cm), respectively. Kornecki et al. [8] stated that only a short bowel segment (less than 5 cm) was involved in small bowel intussusceptions. One ileoileal intussusception, however, had a length of 6 cm on US. The ranges of the length of the intussuscepted structures overlapped. Length alone was therefore not enough to specify the type of intussusception. The mean length determined by US is in accordance with that determined by CT (2.2 cm) reported by Strouse et al. [7]. However, when the lengths of the two types of intussusceptions were compared without inclusion of the patient with Burkitt lymphoma, there was no overlap in the ranges of length of the intussuscepted bowel wall. The length of the ileoileal intussusception in the patient with lymphoma was 6.0 cm. The mean length excluding this patient was 2.1 cm (range, 1.5-3.0 cm) compared with 2.5 cm (range, 1.5-6.0 cm).

Small bowel intussusceptions in children are uncommon. They may be idiopathic, but several pathologic entities are predisposing factors. These include infections, Meckel diverticulum, cystic fibrosis and previous abdominal surgery [7]. Only one lead point (Burkitt lymphoma) was depicted during ultrasonographic examination of the ileoileal intussusceptions in our study. Lymphoma is uncommon in children, but is well known as a predisposing factor for intussusception [1]. One

of our patients had cystic fibrosis and five had gastrointestinal infections. In four children the intussusceptions were idiopathic.

Apart from hypertrophied lymphoid tissue, no other anatomical abnormality was identified on ultrasonography or laparotomy in the children with an ileocolic intussusception. These mesenteric lymph nodes were depicted at US in the ileocolic intussusception. The lymphoid tissue probably functioned as a lead point. This differed from the findings in ileoileal intussusception. Although enlarged mesenteric lymph nodes surrounded the ileoileal intussusceptions, no lymph nodes were depicted inside the intussusceptions.

The vast majority (91%) of the ileoileal intussusceptions in our study required no invasive therapy; they had resolved spontaneously on follow-up US. Kornecki et al. [8] have previously described this phenomenon. In their study, small bowel intussusceptions resolved spontaneously or through pressure of the probe or hand of the examiner. We excluded this transient type of intussusception, and only included intussusceptions that persisted throughout the ultrasonographic examination. Despite exclusion of this transient type of small bowel intussusception, our included ileoileal intussusceptions had also resolved without invasive therapy after several hours or by the next day. It is important to correctly recognize the type of intussusception from its ultrasonographic features, such as diameter and length, and location of the involved bowel, in order that unnecessary enema can be avoided. Most ileoileal intussusceptions resolve spontaneously and ileoileal intussusceptions cannot be treated by enema. In our series ileoileal intussusception was wrongly diagnosed in one patient at presentation as ileocolic intussusception. Enema showed no ileocolic intussusception and following review of the ultrasonographic findings the intussuscepted structure was reinterpreted as an ileoileal intussusception. It showed spontaneous resolution on follow-up US.

This study was limited by the lack of pathologic correlation in most ileoileal intussusceptions because of their spontaneous resolving nature making surgery unnecessary. Patients with ileoileal intussusception only require surgery when there is clinical suspicion of peritonitis, ileus or absent blood flow in the intussuscepted bowel wall on US.

In conclusion, ultrasonographic features, especially diameter and length, can differentiate ileoileal intussusception from ileocolic intussusception. The mean diameter of ileoileal intussusception was 1.5 cm and mean length was 2.5 cm, compared with 3.7 cm and 8.2 cm, respectively, for ileocolic intussusception. Ileoileal intussusceptions resolve spontaneously, invasive treatment is unnecessary when no lead point is depicted by US. Clinical and ultrasonographic follow-up are recommended.

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