Terminal Ileum Intubation in Pediatric Colonoscopy and Diagnostic Value of Conventional Small Bowel Contrast Radiography in Pediatric Inflammatory Bowel Disease

*L. Arturo Batres, *Eric S. Maller, †Eduardo Ruchelli, ‡Soroosh Mahboubi, and *Robert N. Baldassano

*Division of Gastroenterology & Nutrition, †Department of Pathology and ‡Department of Radiology, The Children’s Hospital of Philadelphia, Philadelphia, Pennsylvania, U.S.A.

ABSTRACT

Background: Small bowel contrast radiography is often suggested as the first diagnostic tool in evaluating pediatric inflammatory bowel disease. The purpose of this study was to determine the sensitivity and specificity of small bowel radiography compared with terminal ileal biopsies in diagnosing pediatric inflammatory bowel disease, and to determine the success rate and safety of terminal ileum intubation during pediatric colonoscopy.

Methods: We retrospectively reviewed the records of 164 subjects who had colonoscopies with terminal ileal biopsies between 1994 and 1996. Small bowel contrast radiography was performed in 84 subjects within two weeks of the colonoscopy. We also reviewed all the colonoscopy reports from the years 1994 to 1996 and 1999 to 2000 to determine the percentage of terminal ileal intubation.

Results: Eighty-four subjects with small bowel contrast radiography and terminal ileal biopsies were reviewed. Using small bowel radiography as a screening test for the diagnosis of terminal ileum inflammatory bowel disease resulted in a sensitivity of 45% (17/37) and a specificity of 96% (17/19). Between the years 1994 and 1996 the percentage of pediatric colonoscopies that resulted in terminal ileal intubation was 21.5%; between the years 1999 and 2000 the percentage increased to 65.6%.

Conclusions: A normal small bowel radiography alone should not be used to rule out pediatric inflammatory bowel disease when the symptoms suggest it. Colonoscopy with terminal ileal intubation is feasible and safe; it should be attempted in all children with symptoms consistent with inflammatory bowel disease. JPGN 35:320–323, 2002. Key Words: Inflammatory bowel disease—Pediatrics—Small bowel follow-through—Colonoscopy—Terminal ileum. © 2002 Lippincott Williams & Wilkins, Inc.
with inflammatory disease, but its use has been analyzed in children only recently (6). The expanded use of this diagnostic modality was made possible by technological advances in the manufacture of smaller endoscopes and the training of gastroenterologists skilled in pediatric endoscopy (7). In children, the perceived intolerance of colonoscopy and ileoscopy under conscious sedation, as well as fear of complications, has previously prevented many pediatric endoscopists from attempting intubation of the terminal ileum. Consequently, this has led to a reliance on SBFT to diagnose small bowel disease, especially terminal ileal (TI) disease. The aims of this study were to determine the sensitivity and specificity of an SBFT for the diagnosis of pediatric inflammatory bowel disease and to determine the success rate and safety of terminal ileal intubation during pediatric colonoscopy.

SUBJECTS AND METHODS

We performed a retrospective analysis of the records of all patients who had colonoscopy at the Children’s Hospital of Philadelphia between January 1, 1994 and December 31, 1996. The pathology reports of 637 colonoscopies were reviewed to identify the TI. SBFT was performed in 84 subjects with TI histology within two weeks of ileoscopy. Blinded from the subjects’ clinical diagnoses, a radiologist (SM) and a pathologist (ER) read the radiographs and biopsies respectively. The barium follow-through examinations were performed using a standard technique. Studies were reviewed and the appearance of the distal 10 cm of ileum was classified as either normal or abnormal. Lymphonodular hyperplasia was considered as a normal finding. There was no attempt to grade the severity of the abnormalities seen with SBFT. Non-TI findings from SBFT were not evaluated except in helping to support a clinical diagnosis of CD.

The ileoscopy biopsy findings were classified as either normal or abnormal. Abnormalities of the TI biopsies ranged from abnormal cellularity to severe inflammation. These findings were compared with the results of the SBFT evaluation of the TI.

To evaluate the frequency of TI intubation during colonoscopy, 2,038 endoscopy reports from 1994 to 1996, 637 colonoscopies were obtained from the children’s hospital. SBFT was done in 84 of the 137 patients within two weeks of ileoscopy. Of the 84 patients whose small bowel radiographs and TI biopsies were reviewed, 36 (43%) had CD, 11 (13%) had UC, 5 (6%) had indeterminate colitis, and 32 (38%) were normal.

Abnormal SBFT radiographs were seen in 19 patients, of whom 17 had abnormal TI biopsies. Normal SBFT examinations were seen in 65 patients of whom 20 had abnormal TI biopsies and 45 had normal TI biopsies (Table 1). Therefore, using SBFT as a screening test for the diagnosis of TI Crohn disease, with the TI biopsy as the “gold standard”, resulted in a sensitivity of 46% (17/37) and a specificity of 96% (45/47). The positive predictive value, or the probability that a positive SBFT test result indicates disease, was 90% (17/19), whereas the negative predictive value, or the probability that a negative SBFT test result indicates absence of disease, was 70% (45/65). There was evidence of proximal small-bowel disease, characterized as thickened folds on the SBFT, in 33% (2/6) of the patients with CD that had normal TI biopsies and normal TI on SBFT.

We also reviewed 2,038 endoscopy reports from 1994 to 1996 and 1999 to 2000; 1,516 (74%) procedures were colonoscopies. Table 2 shows the number of colonoscopies per year and the percentage of TI intubation. Between the years 1994 and 1996, 637 colonoscopies with biopsies were performed (average of 212 per year) with a success rate of TI intubation of 21.5%. Between the years 1999 and 2000, 879 colonoscopies with biopsies were performed (average 440 per year) with a success rate of TI intubation of 65.6%. There were two.

**TABLE 1. Results of terminal ileal biopsies and SBFT study of the distal 10 cm of ileum in children with symptoms suggestive of IBD**

<table>
<thead>
<tr>
<th>TI Biopsies (Gold Standard)</th>
<th>Abnormal histology</th>
<th>Normal histology</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small bowel follow-through (Screening Test)</td>
<td>Abnormal study</td>
<td>17</td>
<td>2</td>
</tr>
<tr>
<td>Normal study</td>
<td>20</td>
<td>45</td>
<td>65</td>
</tr>
<tr>
<td>Total</td>
<td>37</td>
<td>47</td>
<td>84</td>
</tr>
</tbody>
</table>

**RESULTS**

Of the 637 colonoscopies reviewed from 1994 to 1996, biopsies of the TI from ileoscopy were obtained from 137 patients. SBFT was done in 84 of the 137 patients within two weeks of ileoscopy. Of the 84 patients whose small bowel radiographs and TI biopsies were reviewed, 36 (43%) had CD, 11 (13%) had UC, 5 (6%) had indeterminate colitis, and 32 (38%) were normal.

Sensitivity, specificity, positive predictive value and negative predictive value for the SBFT study were calculated.
colonic perforations, one in each time period. Between 1994 and 1996 the colonic perforation rate was 0.16% (1/637) and between 1999 to 2000 was 0.11% (1/837).

DISCUSSION

The terminal ileum in a young child is often nodular but later attains a velvety appearance on direct visualization and as seen by contrast radiography in early adulthood. This nodular appearance may easily be misinterpreted as abnormal on SBFT, suggesting the presence of CD. In these instances, the only reliable way of diagnosing IBD is through colonoscopy and terminal ileal biopsy (6). In addition, some reports have suggested a number of false negative results in the SBFT examinations of patients with CD (8).

In 1979, the National Cooperative Crohn Disease Study reported an average of 36 months from the time of the onset of symptoms to the time of diagnosis using the SBFT examination (9). Early radiographic findings of Crohn disease in the small bowel include a coarse villous pattern of the mucosa, thickened folds, aphthous ulcerations, and cobblestoning (10). Ansari et al. (11) concluded that SBFT does not appear to add additional information when compared to ileoscopy for the exclusion of small bowel CD. Colonoscopy with ileum biopsy was shown to be helpful for the diagnosis of inflammatory disorders when radiology of the terminal ileum was abnormal or inconclusive (6,12).

Our results show that SBFT is limited by its low sensitivity in detecting terminal ileum involvement. Approximately 31% of the subjects (20/65) had a normal SBFT study and abnormal TI histology. These findings support the importance of adding ileoscopy with terminal ileum biopsies to colonoscopy in revealing the presence of isolated terminal ileal CD. Albertini et al. (13) also reported a low sensitivity (58%) using SBFT in a study of 28 subjects. A study by Halligan et al. (14) demonstrated the distribution of small bowel disease in children to be approximately 30% in the proximal small bowel, 46% in the mid-small bowel, and 80% in the distal small bowel. The authors emphasized the need for SBFT in the evaluation of children with symptoms consistent with IBD because ileoscopy will miss CD disease proximal to the terminal ileum. Thus, although the SBFT is an important modality in the evaluation of a child with known IBD, it should not be used to exclude IBD if the study is normal. Charron et al. (15) suggested, in a retrospective study of 313 children, that $^{99m}$Tc leukocyte scintigraphy was more sensitive than SBFT as an initial screening modality to exclude IBD.

The technique for the ileocecal valve (ICV) intubation has been previously described in adult patients (16,17). Chen and Khanduja described a simple method to facilitate ileoscopy. Briefly, the ICV is identified and positioned inferiorly (6 o’clock position) by manipulating the colonoscope. The tip of the instrument is then advanced above and beyond the valve and slowly withdrawn with the tip flexed downward until the orifice of the TI is exposed; after that, the colonoscope is advanced forward to intubate the ileum (18). Other authors have suggested a similar technique with the valve in the 12 o’clock position (19). In our institution we position the ICV superiorly between the 10 and 2 o’clock positions. Overdistention of the cecum might make the intubation more difficult, so it is important to minimize the air insufflation to relax the tension of the ICV.

Terminal ileal intubation during colonoscopy was evaluated in a prospective study by Kundrotas et al. (20). The authors included 295 adult subjects with the cecum being identified 91% of the time. Of the colonoscopies with cecal identification, the terminal ileum was successfully intubated 79% of the time.

In our review, we defined a colonoscopy when the colonoscope was passed beyond the splenic flexure. This differed from the flexible sigmoidoscopies, but included procedures in which the endoscopist was attempting to intubate the TI but had difficulties advancing the colonoscope or reaching beyond the hepatic flexure.

The percentages of TI intubation presented in our results differed from one time period to the other (21.5% to 65.6%). The dramatic improvement in the success rate of TI intubation during the last time period may be the result of endoscopes that are smaller and more flexible with improved video image. Also increased experience performing pediatric colonoscopies and changes in the staff may have been responsible for this improvement.

Clinical competency in pediatric endoscopy depends on several factors that include innate talents (visual pattern recognition, hand-eye coordination, and manual dexterity), quality of instruction and extent of experience (7).

Colonoscopy and ileoscopy have demonstrated an excellent safety profile in centers with trained pediatric gastroenterologists. Most children tolerate the procedure with only minor discomfort under conscious sedation with adequate cardio-respiratory monitoring or general anesthesia. There are no previously reported studies on the complication rates in pediatric colonoscopies. It is estimated that the rate of perforation is less than 1% (21). Rates of perforations in adult patients undergoing colonoscopy range from 0.005% to 0.3% (22–24). The colonic perforation rate from our review was less than 0.2% in both groups. This rate was not affected by the increased rate of terminal ileal intubation in the second time period studied.
Our experience suggests that the endoscopist can successfully and safely intubate the TI in pediatric patients. Since a large fraction of children presenting with CD have terminal ileum disease, we recommend that ileoscopy should be attempted during the initial evaluation of pediatric patients with IBD if a colonoscopy is performed. An obvious contraindication to this recommendation would be the presence of acute severe colitis, in which case a limited colonoscopy is indicated to avoid the risk of precipitating toxic megacolon or perforation (25). Treatment can still be instituted in these patients. Ileoscopy can be postponed until the patient can safely tolerate the procedure to more accurately evaluate the extent of the disease.

In conclusion, the child who presents with signs and symptoms of IBD should undergo a colonoscopy and ileoscopy with biopsies to make the diagnosis, as well as to help determine the appropriate therapy. Terminal ileal intubation during colonoscopy is a safe procedure in the pediatric population. With the advances in pediatric endoscopy and the proper technique, TI intubation can be achieved in more than 50% of all colonoscopies. An SBFT is important in the evaluation of IBD but if normal, it should not be used to rule out IBD in a child with symptoms that suggest it.

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REFERENCES