



The role of imaging in the preoperative assessment of children with inflammatory colitis



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ABSTRACT

Background: Accurate diagnosis of Crohn's disease or ulcerative colitis is essential for surgical planning. This study compared the accuracy, safety, and utility of small bowel follow-through (SBFT) and magnetic resonance enterography (MRE) for detecting small bowel (SB) involvement preoperatively.

Methods: A retrospective review of children who underwent colectomy for inflammatory bowel disease (2000–2014) was performed. Preoperative SBFT and MRE were independently reviewed by two radiologists blinded to clinical data. Gold standard for diagnosis was surgical pathology.

Results: 68 patients (36 female) were included. 45 patients had SBFT prior to colectomy, 17 patients had MRE, and 6 both. Interrater reliability for radiologic interpretation was 90% (SBFT) and 91% (MRE). Mean study durations were 190 min (SBFT) and 59 min (MRE). Median effective dose for SBFT was 1.5 mSv, while MRE involved no ionizing radiation. Specificities for diagnosing SB involvement were 87.5% (SBFT) and 94% (MRE). 54 patients underwent subtotal colectomy and ileostomy, 12 restorative proctocolectomy, and 2 colectomy with ileorectal anastomosis. Preoperative imaging correlated with surgical pathology in 83% (SBFT) and 90% (MRE).

Conclusion: MRE is at least as effective as SBFT for assessing SB disease in children with colitis prior to colectomy. MRE requires less time and does not expose children to ionizing radiation.

Retrospective Case Series, Level 4 Evidence.

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Despite the fact that great advances have been made in the treatment of children with inflammatory bowel disease (IBD), colectomy remains necessary for children with complications or those who have failed medical management [1]. Differentiating Crohn's disease (CD) from ulcerative colitis (UC) is a vital aspect of the work-up in patients with IBD, since it may influence prognosis, treatment plan and operative planning [2]. For children with UC, the ideal goal of surgical management is restorative proctocolectomy (in one, two or three stages), which provides a cure. However, restorative proctocolectomy is generally contraindicated in children with CD, given the risk of Crohn's recurrence in the J-pouch [3]. In up to 30% of children a diagnosis of CD or UC cannot be confidently made and these children are termed to have IBD-U (or "unclassified"), previously termed "indeterminate colitis" [4,5]. Overuse of this term can lead to uncertainty in clinical decision-making,

specifically when discussing surgical options of a permanent stoma versus ileoanal pouch reconstruction [6].

The presence of small bowel granulomatous lesions aids in distinction of CD from UC, and several methods exist to evaluate the small bowel for evidence of IBD. The revised Porto criteria recommend upper gastrointestinal endoscopy and ileocolonoscopy for all patients with suspected IBD [7]. Features such as macroscopic cobblestoning, segmental colitis, ileal stenosis and ulceration, perianal disease and granulomas all strongly suggest a diagnosis of CD rather than UC [6]. Other methods of evaluating the small bowel include video capsule endoscopy and laparoscopy. These are all, however, invasive procedures with risks and may require sedation or general anesthesia. For these reasons, there has been increased interest in determining the most effective means of evaluating children radiologically prior to colectomy.

Traditionally, small bowel follow-through (SBFT) or enteroclysis has been used in this setting (the latter rarely at our institution). Both can be technically challenging exams, and can expose the child to a significant amount of radiation. Enterography utilizing computed tomography (CT) has been widely used, more commonly in the adult population, but given the high dose of radiation associated with CT it has generally been avoided in children. Magnetic resonance enterography (MRE) is

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therefore replacing other imaging modalities in identifying small bowel disease in IBD, particularly in pediatrics [8,9]. This technique uses enteral contrast to optimally view the small bowel in its entirety and has been proven to be highly sensitive for identifying inflammation and strictures [10]. Although magnetic resonance enteroclysis, using fluoroscopy to guide nasojejunal tube insertion to instill enteric contrast, has been shown to have higher sensitivity than MRE (e.g., shallow erosions), the general consensus is that the disadvantages of ionizing radiation and patient discomfort, particularly in children, have limited its widespread adoption [11].

The aim of this study was to compare our experience with SBFT and MRE in the pediatric population for the preoperative assessment of small bowel disease in children requiring colectomy for IBD.

1. Methods

This study was approved by the institutional research ethics board at our large tertiary care pediatric hospital (REB #1000047732). A retrospective chart review was performed on all children who underwent a colectomy for IBD between 2000 and 2014. Patients were identified, via the operating room census, for all patients undergoing a colectomy. We then excluded patients who had a colectomy for a reason other than IBD (e.g., *Clostridium difficile* colitis, familial polyposis coli) and those children who did not have preoperative imaging in the form of SBFT or MRE (e.g., children who underwent emergency colectomy for toxic megacolon). Children younger than 18 years were included in the review. Chart review was used to collect clinical, endoscopic, operative and pathologic data.

The standard institutional technique for SBFT involved oral ingestion of barium, with a nasogastric tube (NGT) employed in uncooperative patients, and fluoroscopic screening to observe transit of contrast to the duodenojejunal flexure/proximal jejunum. A series of delayed images, fluoroscopic “spot” films and/or radiographs, were then obtained until contrast reached the ileocecal region, when targeted imaging was performed, occasionally with local compression, to optimize visualization of the terminal ileum (Fig. 1). Static images only (not video) were available for review in this study.

The standard institutional MRE protocol involved ingestion of 3% Sorbitol orally, occasionally via NGT as for SBFT, as a weight-based volume given in 3 divided doses over one hour prior to scanning.

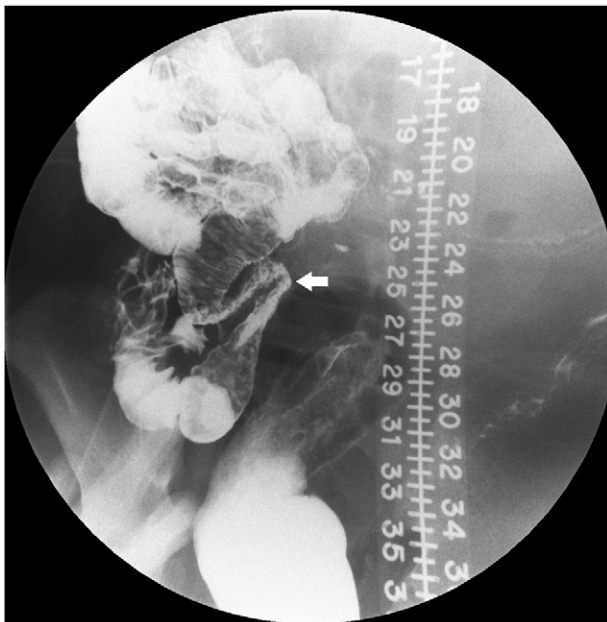


Fig. 1. Small bowel follow-through in an 11-year-old boy confirmed to have Crohn's disease—"spot" radiograph demonstrates a stricture in the terminal ileum (arrow).

Scout imaging was obtained to ensure contrast had reached the ileocecal region. Following a cinematic sequence, an antispasmodic agent was administered intravenously and a series of coronal and axial sequences acquired using balanced steady-state free precession, single shot T2 and preintravenous and postintravenous gadolinium-based contrast fast T1 gradient echo sequences [12] (Fig. 2).

The preoperative studies (SBFT and MRE) were independently reviewed by two radiologists, specifically looking for evidence of small bowel disease, using the institutional Picture Archive and Communication System (PACS—GE Centricity PACS Radiology RA1000 Workstation, Barrington IL). The radiologists were blinded to clinical data, including the report of the original radiologist interpreting the study. Radiologists were asked to make a diagnosis of UC, CD or IBD-U based on their interpretation of the examination. Interobserver reliability was used to compare the two radiologist interpretations. For studies that were not agreed upon, a consensus read was performed.

Procedure times and age at imaging were obtained for SBFT and MRE from PACS by the reviewing radiologists and a medical imaging technologist (MRT). Radiation dose estimation data for SBFT were collated by the MRT, and estimates computed using fluoroscopic dose indices extracted after each applicable examination by a medical physicist. These indices were calculated quantities provided by the x-ray equipment accounting for radiation output, technique, spectral filtration, and collimated field size. Dose indices for radiographic images were measured using techniques and geometry based on patient age and body habitus. Representative effective dose values were subsequently calculated using Monte Carlo modeling software (PCXMC 2.0; STUK, Helsinki, Finland), incorporating relevant assumptions and all available dosimetric information. Procedures without dose metrics were not evaluated.

Interrater reliability was calculated using Cohen's kappa value. Surgical pathology was considered the gold standard for diagnosis of CD or UC, and this was compared to the radiologist read on SBFT and MRE to calculate the specificity and sensitivity of detecting small bowel disease in each study.



Fig. 2. Magnetic resonance enterography in a 16-year-old boy with ulcerative colitis. Coronal postcontrast fat-suppressed fast T1 gradient echo sequence shows (i) reflux ileitis in the terminal ileum (arrow) with wall thickening and hyperenhancement, (ii) pancolitis with mild wall thickening and enhancement in cecum and descending/sigmoid colon (arrowheads), with (iii) minimal periintestinal or pericolonic mesenteric change.

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