



## Routine contrast enema is not required for all infants prior to ostomy reversal: A 10-year single-center experience



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### ABSTRACT

**Introduction:** The incidence of intestinal stricture is low for most conditions requiring a primary small bowel stoma in infants. Routine performance of contrast enemas (CE) prior to stoma closure adds cost and radiation exposure. We hypothesized that routine CE prior to ostomy reversal is not necessary in all infants, and sought to identify a subset of patients who may benefit from preoperative CE.

**Methods:** Medical records of infants under age 1 (N = 161) undergoing small bowel stoma reversal at a single institution between 2003 and 2013 were retrospectively reviewed. Student's T-test was used to compare groups.

**Results:** Contrast enemas were performed on 80% of all infants undergoing small bowel ostomy reversal during the study period. Infants with necrotizing enterocolitis (NEC) were more likely to have a CE than those with intestinal atresia ( $p = 0.03$ ) or those with all other diagnoses combined ( $p = 0.03$ ). Nine strictures were identified on CE. Of those, 8 (89%) were in patients with NEC, and only 4 were clinically significant and required operative resection. The overall relevant stricture rate was 2.5%. No patient that underwent ostomy takedown without CE had a stricture diagnosed intraoperatively or an unrecognized stricture that presented clinically after stoma takedown.

**Conclusions:** Routine CE is not required prior to small bowel ostomy reversal in infants. We recommend judicious use of enema studies in patients with NEC and high likelihood of stricture.

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Infants often require emergent laparotomy and small bowel ostomy for fecal diversion when diagnosed with potentially life-threatening gastrointestinal disorders. Diseases such as necrotizing enterocolitis (NEC), focal intestinal perforation (FIP), and intestinal atresia may require an ileostomy or jejunostomy during the acute phase of illness. Typically the enterostomy can be reversed to restore gastrointestinal continuity and allow for normal defecation after resolution of the inciting pathologic process and a period of clinical stability. Clinically, a well-functioning stoma is indicative of unobstructed proximal intestine. However, in order to achieve a safe and functional closure, the distal intestine must also be free of obstruction. For years, adult surgical dogma has mandated the routine use of contrast enema (CE) prior to ostomy closure to confirm the absence of a distal obstruction. This approach has been commonly applied in pediatric surgical practice, regardless of the indication for initial ostomy. The importance of radiographic imaging in diagnosing distal obstruction prior to initial operation (stoma creation) is well established in patients with Hirschprung's disease in identifying the transition zone, and meconium ileus since a nontrivial rate of distal obstruction, stenosis or residual inspissated meconium is well described [1,2].

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Many pediatric surgeons routinely perform preoperative CEs prior to ostomy reversal in order to evaluate the distal intestine for obstruction or stricture. Some argue that it is necessary because of the technical challenge of evaluating the distal colon intraoperatively. However, without considering the primary diagnosis, there is little evidence to support its routine use. Furthermore, the practice is costly and may harbor more risk than benefit, particularly the harmful risk of radiation.

Studies to determine the necessity of a preoperative CE have been performed in other patient populations and suggest that CEs are unnecessary in asymptomatic patients, are often falsely positive, add expense and delay, and do not change management or improve outcomes overall [3–8]. There have been no studies to date evaluating the use of preoperative CE in infants prior to ileostomy closure. We suspect that its use is unnecessary for most infants undergoing small bowel ostomy reversal and propose that routine use be eliminated from the treatment algorithm thereby saving time, reducing radiation exposure, and decreasing healthcare costs.

To date, no study has evaluated the utility of routine preoperative contrast enemas in infants.

The purpose of this study was to evaluate the patterns of use and the diagnostic yield of preoperative CE in infants at a single children's hospital. In particular, we aimed to determine the frequency and accuracy of preoperative CE in diagnosing strictures or obstructions, and what, if any, change in management followed. We hypothesized that routine

CE prior to ostomy reversal was not necessary in all infants and sought to identify a subset of patients at increased risk for distal obstruction who may benefit from its use preoperatively.

## 1. Materials and methods

The research protocol was approved by the institutional review board (CCI# 12–00,371).

A single-center retrospective chart review was performed over 10 years (2003–2013). Potential patients were identified by a search of current procedural terminology (CPT) codes for 'ileostomy', 'enterostomy', and 'enterostomy closure' in patients less than 12 months of age. Chart review included diagnosis codes, operative details, and radiographic findings. All patients less than one year of age undergoing reversal of a small bowel ostomy (jejunostomy or ileostomy) were included. For infants with a coding diagnosis of 'perforation of intestine' or 'perinatal intestinal perforation', chart review was conducted to further define the diagnosis. Exclusion criteria were patients undergoing preoperative CE or distal pressure colostograms prior to closure of a large bowel stoma, and those with primary colon or anorectal disorders with a diverting/protective small bowel ostomy. Among infants with contrast enemas suggestive of stricture, operative notes and follow-up clinic notes were further analyzed.

### 1.1. Statistical analyses

Statistical analysis was performed with student's t-test. Values are expressed as mean  $\pm$  SD except where noted. P values  $<0.05$  were considered significant. Sensitivity, specificity, and positive and negative predictive values were also calculated.

## 2. Results

Over the ten-year study period, 387 procedures were billed under the CPT codes for enterostomy closure. Of these, 192 were colostomy closures, all of which were excluded. Of the 195 infants who underwent closure of small bowel ostomies, 34 were excluded owing to [1] inaccurate procedure codes [2], diverting ileostomies or [9] specialized ostomy procedures for urologic anomalies. The final analysis included 161 infants. The most common primary diagnoses were necrotizing enterocolitis (NEC) (N = 78), focal intestinal perforation (FIP) (N = 25), jejunoleal atresias (N = 31), and meconium peritonitis (N = 10).

The overall utilization rate of preoperative CE in all infants was 80%. The diagnosis with the highest preoperative CE utilization rate was meconium disease (90%), followed by NEC (85%), and FIP (80%). Infants with NEC were more likely to have a CE prior to ostomy reversal than infants with atresia ( $p = 0.04$ ) or infants with all other diagnoses combined ( $p = 0.03$ ). (Table 1).

Of 133 CEs performed in our cohort, only 9 (6.7%) were read by the radiologist as positive for a stricture. Strikingly, 8/9 (89%) of CEs reported as suggestive of colonic strictures were in infants with a diagnosis of NEC. Upon review of operative dictations, strictures requiring resection were confirmed in only 4 of the 9 infants with a preoperative CE suggestive of a stricture, and who had a diagnosis of NEC. The overall confirmed stricture rate was 5% for infants with NEC and 2.5% overall. Among infants with a diagnosis of NEC, all clinically relevant strictures

were identified by CE, and no strictures were found in infants with a reportedly normal contrast enema, making the sensitivity and negative predictive value both 100%. There were more false positives than true positives resulting in a low positive predictive value (44%) and specificity (92%) (Table 2).

Sixty-six percent (6/9) of infants with CEs suggestive of stricture, and 80% (4/5) of those with false-positive CEs had colon resections during their initial operation. Among infants who underwent ostomy reversal without a preoperative CE, none were found to have a distal intestinal stricture at the time of operation. Furthermore, none of these infants went on to develop clinical signs of bowel obstruction or required additional surgery. Infants with CEs suggestive of stricture were monitored closely in the postoperative period and had an average follow-up of 21 months. The subset of infants with a false-positive CE had a shorter mean follow-up period of 10 months.

## 3. Discussion

Preoperative contrast enemas are frequently performed prior to small bowel ostomy reversal in infants with no data to support its routine use. While traditional surgical teaching encourages its use, our data reflect an 80% overall utilization rate of preoperative CE with only a 2.5% clinically relevant incidence of stricture. Of the patients included in our cohort, 124 infants (77%) had a normal study and 5 patients were incorrectly diagnosed with a stricture. The only strictures diagnosed in our cohort on CE or intraoperatively were in infants with a diagnosis of NEC, suggesting that nonselective use of CE may be unnecessary, costly, and potentially harmful to our smallest patients.

While CEs are relatively noninvasive, they add cost and risk to the care of infants with ostomies. The most worrisome risk involved with the routine use of CEs is exposure to ionizing radiation and an increased lifetime cancer risk. In adults, the average effective dose of a barium enema is 8 mSv, approximately 400 times that of a routine PA chest radiograph (typical dose 0.02 mSv). While at most institutions doses in children are age adjusted resulting in significantly lower radiation exposure than in adults, a barium enema in infants less than a year of age carries a typical effective radiation dose of 0.81 mSv [9]. The radiation dose per CE at our institution was not available, but with the literature approximating a dose 40 $\times$  that of a routine chest X-ray, it is critical that physicians evaluate the frequency and necessity of CE use in infants.

According to guidelines published by the National Cancer Institute, children's developing tissues are more sensitive to radiation than adult tissues, and their relatively longer potential lifespan allows an increased length of time within which they can express radiation damage [10]. While there is no safe dose of radiation, studies of cancer risk after CT scans in children have shown that the risks of leukemia and brain tumors increase linearly with increasing total radiation dose. For a cumulative dose of 50 mGy to the head or bone marrow, there is a three-fold increase in the risk of brain tumors and leukemia, respectively [11]. These estimates can reasonably be extrapolated to other diagnostic tests involving ionizing radiation, such as CEs as examined in our study. Additionally, while the cost of a CE varies widely in price, they undoubtedly add to health care expenses. Bucher et al. quote the baseline value of a CE at approximately US \$4700 [12]. Nonselective use of CE resulted in 77% of our study population undergoing a normal

**Table 1**  
Diagnoses of infants undergoing small bowel ostomy reversal.

Diagnosis	N	Contrast enema	Utilization rate	Stricture diagnosed by enema	Stricture confirmed in OR
NEC	78	67	85%	8 (12%)	4 (5%)
FIP	25	20	80%	0	0
Atresia	31	23	74%	0	0
Meconium Disease	10	9	90%	0	0
Other	17	14	82%	0	0
<b>Total</b>	161	133	80.1%	5.5% strictures diagnosed on contrast enema	2.5% actual stricture rate

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