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Timing contrast studies prior to enterostomy closure in necrotising enterocolitis

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Abstract

Aims

Intestinal stricture post-necrotising enterocolitis is a significant cause of morbidity and mortality. Preoperative enteral contrast studies remain a key diagnostic study, although the ideal timing remains debatable. The primary aim was to define the stricture formation rate and optimal timing of preoperative enteral contrast studies.

Methods

Consecutive patients with necrotising enterocolitis requiring laparotomy and enterostomy formation at Our Lady's Children's Hospital Crumlin between 2016 and 2020 were identified from a retrospective database. Univariable analysis was performed to assess whether delays between ECS and enterostomy closure was correlated with increased frequency of intestinal strictures.

Results

Twenty-four patients met inclusion criteria. Eleven patients had intestinal strictures confirmed at enterostomy closure. Median delay between imaging and enterostomy closure was 6 weeks. In patients without strictures, the median delay between imaging and enterostomy closure was 4 weeks. Patients with diagnostic imaging >4 weeks after the index surgery had a trend towards stricture formation.

Discussion

Preoperative enteral contrast studies are routinely performed to obviate the need for complete intraoperative bowel inspection during enterostomy closure. The diagnostic yield of enteral contrast studies on late strictures is reduced when performed too early. We recommend repeating the study or actively visualizing the distal bowel at time of closure when delays occur.

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Introduction

Intestinal Strictures (IS) in patients with Necrotising Enterocolitis (NEC) occur at a rate of up to 40%.[1] The pathophysiology of these strictures relates to bowel ischaemia and/or perforation with subsequent healing, fibrosis, and a variable degree of stenosis.[2] As the enterostomy is usually created proximal to the perforation or ischaemic bowel, distal strictures may not be obvious prior to enterostomy closure. Bowel patency can be assessed intra-operatively at the time of enterostomy closure by simple inspection of the entire distal bowel and/or flushing saline through the bowel. Unfortunately, this inspection requires extensive surgical dissection with associated additional morbidity. It is therefore common practice to perform enteral contrast studies (ECS) to assess distal bowel patency and identify strictures prior to enterostomy closure. There are currently no screening guidelines regarding assessment of IS after NEC. Timing is clinician dependent and they are most commonly performed 3 to 4 months after enterostomy formation once the acute phase of NEC has resolved and other comorbidities have been addressed.[1] Contrast enema has been previously shown to have a higher sensitivity than distal loopogram, although in practice, where there is clinical doubt, both studies may be performed.[4]

The development of IS may not be confined to the early acute inflammatory phase of NEC. We recently published a case-report of an infant who developed a radiologically occult stricture that was identified 14 months after NEC.[5] Multiple studies have reported cases where IS have been detected up to 20 months after an acute episode of NEC.[6] The timing of preoperative ECS on the decision to perform complete bowel inspection during enterostomy closure remains an area of ongoing debate. The primary aim of this study was to define the rate of IS formation and the timing of preoperative ECS prior to definite treatment.

Methods

Patient Selection

This is a retrospective study assessing the rate of stricture formation in patients with NEC from 2016-2020 in a single institution. Patients were identified through cross referencing hospital electronic operating theater records with the Hospital In-patient Enquiry (HIPE) system. Inclusion criteria included patients who had an acute episode of NEC requiring enterostomy formation and exclusion criteria were patients with medically-treated NEC or who underwent primary anastomosis.

Clinical Variables

Demographic characteristics reviewed included corrected gestational age and birth weight. Continuous variables included time from index procedure to ECS, and time from ECS to

enterostomy closure. Type of ECS used, frequency of IS formation, location of IS and surgical complications are reported as discrete variables.

Primary outcome

The primary outcome reported is the frequency of IS based on timing of ECS. The patient population was divided into two groups based on timing Of ECS ≤ median and > median.

Statistical analysis

Data analysis initially compared characteristics in subgroups of patients with IS and without IS. In this analysis discrete variables are presented as whole numbers and percentages. Continuous variables are presented using medians. The mean was used exclusively in reporting birth weights and corrected gestational age. Univariable analysis was performed to assess the primary outcome. Continuous variables in this analysis were reported as median with interquartile Range (IQR). Fisher's Exact test was used and data was reported as unadjusted odds ratio with p-value and confidence intervals.

Results

32 patients were identified as having an acute episode of NEC requiring surgical intervention in the allotted time period. 2 patients met exclusion criteria. One underwent primary anastomosis and another was transferred to another institution after enterostomy formation and no data could be obtained. Six further patients were excluded due to mortality after primary procedure, leaving 24 patients for review.

Twenty patients were born preterm (83%) and four were born full term (20%). Three out of four (75%) of the term infants had congenital heart disease. Mean birth weight in the preterm and term populations was 1.36kg and 3.65kg respectively. Mean gestational age at birth was 29 weeks in the preterm population and 39 weeks in the term population. Eleven patients had IS present on imaging and confirmed intra-operatively at enterostomy closure (46%). Twelve patients had no IS present on imaging or intraoperatively. One patient had a false positive result with distal loopogram demonstrating an ileocolic stricture, but no evident stricture present intraoperatively.

In the cohort of 11 patients who developed IS, 8 were born preterm and 3 full-term. Nine were assessed with combined distal loopogram and contrast enema and 2 were assessed with contrast enema alone due to difficulty cannulating the enterostomy site. There were 10 colonic strictures and 2 ileocecal strictures identified in total. The median time between enterostomy formation and imaging was 11 weeks. The median delay between imaging and enterostomy closure was 6 weeks . In three particular cases, enterostomy closure was delayed for greater than 30 weeks. Only 2 patients had complications post enterostomy closure (18%). In one case Enterostomy closure was delayed by 44 weeks after imaging due to Covid-19 pandemic delays .[5] This patient developed a bowel obstruction after enterostomy closure and

required laparotomy and enterostomy reformation due to a new stricture which was not present on initial contrast imaging.[5] There was one mortality post enterostomy closure in a separate patient due to cardiac comorbidities.

In the cohort of 13 patients without IS, 12 were born preterm and 1 full-term. Seven patients were assessed with distal loopogram alone, 4 with contrast enema alone and, 2 with combined distal loopogram and contrast enema. One patient did not undergo contrast imaging prior to enterostomy closure. The choice of imaging was clinician dependent. The median time between enterostomy formation and imaging was 14 weeks. The median delay between imaging and enterostomy closure was 4 weeks. Only 2 patients had postoperative complications (15%). One patient developed an anastomotic leak and another developed a bowel obstruction secondary to an incisional hernia after enterostomy closure. Both required laparotomy and enterostomy reformation.

Median time between imaging and enterostomy closure for the entire cohort was 4 weeks IQR (0.71 - 6.7). The patient population was divided into those who underwent enterostomy closure ≤ 4 weeks after assessment with ECS and those who underwent closure > 4 weeks after ECS. One patient was excluded from this analysis as they did not have interval imaging between enterostomy formation and closure. Eleven patients underwent enterostomy closure ≤ 4 weeks after assessment with ECS (Group 1) and Twelve patients underwent closure > 4 weeks after ECS (group 2). Five patients in group 1 had IS identified at enterostomy closure compared to 6 patients in group 2 (OR: 1.64, 95% CI 0.24 – 11.8, p-value 0.68).

Discussion

Necrotising Enterocolitis is an acute inflammatory condition culminating in intestinal necrosis and death.[7] The pathophysiology of NEC is multifactorial relating to vascular insufficiency, an underdeveloped immune system, local or global hypoxia and bacterial colonisation.[7] Treatment of NEC is multidisciplinary and surgical intervention is indicated where there is intestinal perforation or sepsis refractory to medical management.[8] Surgical intervention involves resection and primary anastomosis or enterostomy formation and bowel rest.[9] In our institution, enterostomy formation at initial laparotomy is the preferred method of surgical treatment.

The impetus to perform this 4-year retrospective study on NEC strictures was the previously mentioned case.[5] A late intestinal stricture developed in an infant up to 56 weeks after the acute episode of NEC.[5] A recent systematic review has highlighted that earlier initiation of enteral feeding reduces the risk of IS.[10] In this case, the patient had feeding difficulties and congenital cardiac disease and ileostomy closure took place 44 weeks after ECS due to COVID-19 pandemic delays.[5] It is likely that a partially ischaemic segment of sigmoid colon continued

to narrow into a stricture during this delayed period. The goal of this study was to attempt to correlate delays in enterostomy closure with an increased risk of IS formation. Our findings suggest the median delay between contrast imaging and enterostomy closure was shorter in the cohort of patients who did not develop IS but the study was limited by a small patient population. Aside from the aforementioned case, no other patients developed new IS after their ECS. There was a trend toward increased frequency of IS in patients who underwent enterostomy closure > 4 weeks after ECS but statistical significance was not achieved. The surgical outcome after enterostomy closure was positive, with only 1 mortality secondary to cardiac comorbidities. Three patients required laparotomy and reformation of enterostomy: for parastomal hernia, anastomotic leak and late stricture.

To the author's knowledge, there have been no prospective studies assessing the risk of developing IS and the timing of stricture formation after an acute episode of NEC. Although the pathophysiology is hypothetically evident - involving circumferential wound healing, fibrosis and stenosis, screening guidelines regarding the appropriate timing and imaging assessment have not been devised. Our current results indicate that in rare cases, late strictures may be missed on imaging if it is performed too far in advance of enterostomy closure. Given the current available evidence base, when unavoidable delays occur between imaging studies and enterostomy closure, we recommend repeating the ECS or actively visualizing the distal bowel at the time of closure. Several other institutional retrospective reviews have been conducted similar to our current study.[1,3,4] Investigation into this topic in the form of prospective studies and/or a systematic review is required to provide a foundation for the development of suitable guidelines regarding the timing of ECS prior to enterostomy closure and prevent unnecessary re-intervention.

Declaration of Conflicts of Interests:
None declared.

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