

## ASSOCIATION FOR ACADEMIC SURGERY

# Stomal Complications in the Newborn with Necrotizing Enterocolitis

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**Background.** Infants who develop necrotizing enterocolitis (NEC) are usually managed with fecal diversion. The integrity of the bowel being diverted is often suboptimal. Our clinical impression is that stomas created in this circumstance are fraught with complications. The purpose of this study is to quantify the rate of these complications and identify risk factors.

**Methods.** A retrospective data collection from May 1999 to May 2008 on infants undergoing laparotomy for NEC was conducted. Data collected included gestational age, birth weight, age, and weight at operation, indications for surgical therapy, procedure performed, time to stoma output, time to takedown of stoma, complication directly related to the ostomy, and mortality. Data comparisons were analyzed statistically using  $\chi^2$ , Pearson's correlation, Fisher's exact test, or a 2-tailed Student's *t*-test with significance reported for  $P < 0.05$ .

**Results.** A total of 73 patients were identified. Mean gestational age was 28 ( $\pm 4$ ) wk, mean birth weight was 1247 ( $\pm 713$ ) g. Mean age at the time of surgery was 23 ( $\pm 27$ ) d, and mean weight at operation was 1513 ( $\pm 1306$ ) g. The most common indication for surgical intervention was pneumoperitoneum ( $n = 43$ , 58%). The most common level of intestinal diversion was the ileum ( $n = 63$ , 85%). In-house mortality was 13%. There were 31 patients (42%) who developed 32 stoma-related complications. Demographic or preoperative variables that were a significant predictor of stoma-related complications were gestational age ( $P = 0.003$ ) and preoperative weight ( $P = 0.024$ ).

**Conclusion.** Premature infants carry a risk for developing stoma-related complications. Within that cohort, there is significantly increased risk of stoma-related complications in patients who are younger in

gestational age and who have low preoperative weight. Future prospective studies may allow insight into preventative practices. © 2009 Elsevier Inc. All rights reserved.

**Key Words:** necrotizing enterocolitis; complications; newborn; stoma; ileostomy.

## INTRODUCTION

Necrotizing enterocolitis (NEC) occurs in approximately three in 1000 live births, and makes up about 1% to 8% of all neonatal intensive care unit (NICU) admissions [1, 2]. It is a severe inflammatory disorder of the intestine with a poorly understood etiology. NEC is a significant cause of morbidity and a major cause of mortality, especially for neonates undergoing surgery [3]. Greater than 90% of affected patients are premature, with more than 80% of afflicted patients weighing less than 2000 g [4, 5].

The medical management of NEC consists of aggressive resuscitation, bowel rest, broad-spectrum antibiotics, and meticulous surveillance for clinical deterioration and/or intestinal perforation. However, up to 50% of patients with NEC will fail medical management and require urgent surgical intervention [6]. While there is no clear algorithm on the best operative strategy for these patients, in general, the standard surgical approach consists of a laparotomy with resection of necrotic bowel and creation of intestinal stomas.

Exteriorization of stomas in this setting often involves diverting a section of bowel, whose viability may be suboptimal. In addition, the bowel size is small, the abdominal wall is thin, there is poor skin integrity, and diffuse systemic illness is present. These characteristics should be risk factors that lead to a substantial rate of postoperative stomal complications. In this study, we reviewed our experience with stomal complications after surgical intervention for NEC, in an

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attempt to quantify the incidence of these complications and identify potential preoperative risk factors.

**METHODS**

A retrospective chart review was performed after approval from the Institutional Review Board. The study population included all newborn patients diagnosed with NEC who underwent laparotomy and creation of a diverting ostomy between May 1999 and May 2008.

Demographic data included gestational age, birth weight, age and weight at operation, and gender. Additionally, the indication for operation, location of the stoma, and level of the stoma were identified. Outcome variables recorded included 30 d mortality, number of days to stool output, type of stoma related complications, ability of the patient to be weaned off of parenteral nutrition prior to hospital discharge, age at ostomy closure, and related complications.

The complication of retraction was defined as a stoma that regressed to below the level of the skin. Skin excoriation was diagnosed and noted in the patients medical records by our stoma nurses when the patients exhibited skin breakdown around the ostomy. Stricture was considered a complication when any stoma needed surgical revision or bedside dilations for partial or complete mechanical obstruction.

**Statistical Analysis**

Data comparisons were made using a 2-tailed Student's *t*-test for continuous variables, and Fisher's exact test for discrete variables with Yates correction where appropriate. Pearson's correlation was used to measure the existence of any linear relationship between patient preoperative variables and the development of complications. Significance was defined as a  $P \leq 0.05$ . Data are presented as mean  $\pm$  standard deviation.

**RESULTS**

**Patient Characteristics**

We identified a total of 73 patients for review. Demographic data is presented in [Table 1](#).

**Surgical Intervention**

The most common indication for initial surgical intervention and stoma creation, overall, was pneumoperitoneum (58%), followed by clinical deterioration of the patient (20%). The most common level of intestinal diversion was the ileum (85%), followed by the jejunum (12%) and colon (3%).

**Outcomes**

In-house mortality was 13%. There were a total of 32 stoma-related complications that developed in 31 pa-

tients (42%). We identified a total of six different stoma-related complications that are displayed in [Table 2](#).

Pearson's correlation was used to evaluate all continuous preoperative and demographic variables. A significant correlation was identified with stoma complications and gestational age ( $P = 0.003$ ) in addition to preoperative weight ( $P = 0.024$ ).

**DISCUSSION**

NEC is a potentially devastating disease process with a high rate of morbidity and mortality. Patients most at risk for developing life threatening complications associated with NEC are premature infants.

The standard approach for neonates with perforated or necrotic bowel continues to be resection of involved bowel with the creation of intestinal stomas [7]. Although surgical removal of nonviable intestine can potentially be a life saving maneuver, the postoperative complication rate in this patient population can be as high as 50%, with mortality rates up to 80% reported in very low birth weight (VLBW) infants [8, 9].

The results of our study show a statistically significant risk of postoperative stoma-related complications in infants born early in gestation and of low birth weight. It is apparent that complications will occur more commonly in less mature babies, as is evident by the correlation results.

This series demonstrated an overall stoma related complication rate of 43% for the six variables we identified: retraction, necrosis, stricture, skin excoriation, prolapse, and prolapse. Our incidence of stomal retraction was 5%. This figure is in line with the 3% to 17% reported in the literature, although the reported incidence in the neonatal population is limited [10, 11]. Often, the cause of retraction is either tension or intestinal necrosis. The likely etiology of retraction in this population is multifactorial. Since the goal of intestinal resection is to remove only the bowel that is obviously necrotic, often the integrity of the bowel being exteriorized is marginal. Once brought out as a stoma, this less than ideal bowel segment can subsequently atrophy and, along with

**TABLE 1**

**Demographic Data for Total Patient Population**

Gender M:F	43:30
Mean gestational age (wk)	28 ( $\pm 4$ )
Mean birth weight (g)	1247 ( $\pm 13$ )
Mean age at surgery (d)	23.5 ( $\pm 27.7$ )
Mean weight at surgery (g)	1513 ( $\pm 1306$ )

**TABLE 2**

**Stoma-Related Complications**

Complication	N
Retraction	4 (5%)
Skin excoriation	4 (5%)
Prolapse	6 (8%)
Necrosis	5 (7%)
Stricture	11 (15%)
Parastomal hernia	2 (3%)
Total	32 (43%)

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