

# Deconstructing dogma: Nonoperative management of small bowel obstruction in the virgin abdomen

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<b>BACKGROUND:</b>	Management of small bowel obstruction (SBO) has become more conservative, especially in those patients with previous abdominal surgery (PAS). However, surgical dogma continues to recommend operative exploration for SBO with no PAS. With the increased use of computed tomography imaging resulting in more SBO diagnoses, it is important to reevaluate the role of mandatory operative exploration. Gastrografin (GG) administration decreases the need for operative exploration and may be an option for SBO without PAS. We hypothesized that the use of GG for SBO without PAS will be equally effective in reducing the operative exploration rate compared with that for SBO with PAS.
<b>METHODS:</b>	A post hoc analysis of prospectively collected data was conducted for patients with SBO from February 2015 through December 2016. Patients younger than 18 years, pregnant patients, and patients with evidence of hypotension, bowel strangulation, peritonitis, closed loop obstruction or pneumatosis intestinalis were excluded. The primary outcome was operative exploration rate for SBO with or without PAS. Rate adjustment was accomplished through multivariate logistic regression.
<b>RESULTS:</b>	Overall, 601 patients with SBO were included in the study, 500 with PAS and 101 patients without PAS. The two groups were similar except for age, sex, prior abdominal surgery including colon surgery, prior SBO admission, and history of cancer. Multivariate analysis showed that PAS (odds ratio [OR], 0.47; $p = 0.03$ ) and the use of GG (OR, 0.11; $p < 0.01$ ) were independent predictors of successful nonoperative management, whereas intensive care unit admission (OR, 16.0; $p < 0.01$ ) was associated with a higher likelihood of need for operation. The use of GG significantly decreased the need for operation in patients with and without PAS.
<b>CONCLUSIONS:</b>	Patients with and without PAS who received GG had lower rates of operative exploration for SBO compared with those who did not receive GG. Patients with a diagnosis of SBO without PAS should be considered for the nonoperative management approach using GG. ( <i>J Trauma Acute Care Surg.</i> 2018;85: 33–36. Copyright © 2018 Wolters Kluwer Health, Inc. All rights reserved.)
<b>LEVEL OF EVIDENCE:</b>	Therapeutic, level IV.
<b>KEY WORDS:</b>	Gastrografin; small bowel obstruction; virgin abdomen.

Historically, the management of an acute small bowel obstruction (SBO) followed the motto, “the sun should never rise and set on a complete small bowel obstruction.”<sup>1</sup> More recently, nonoperative management of SBO has become the primary management approach in patients with previous abdominal surgery (PAS), especially when the obstruction appears partial. In patients with no PAS, the need for operative exploration is still strongly encouraged because of the perceived incidence of underlying obstructive lesions.<sup>2</sup>

Gastrografin (GG) administration has been considered both safe and efficacious for the nonoperative management of SBO.<sup>3</sup> However, there remains a disparity in the reported

outcomes of multiple randomized control trials, which investigated the efficacy of administering GG, a hyperosmotic water-soluble oral contrast agent and have come up with mixed results.<sup>4–8</sup> Most of the ongoing research has been aimed at adhesive SBO, but our study focuses on patients with no PAS who have lower chances for adhesive disease.<sup>9</sup> This study reevaluates the role of mandatory operative exploration in SBO and further investigates the use of GG as a therapeutic nonoperative approach in reducing operative exploration rates in the virgin abdomen. We hypothesized that the use of GG for SBO without PAS will be equally effective in reducing the operative exploration rate compared with that for SBO with PAS. The purpose of this study was to determine the rate of exploration in patients with and without PAS.

## METHODS

Our study population consisted of the EAST multi-institutional (14 institutions) SBO data set of 714 patient records collected from February 2015 through December 2016. Inclusion criteria included patients older than 18 years and with SBO.<sup>9</sup> We excluded patients younger than 18 years, pregnant patients, and patients who presented with evidence of hypotension, bowel

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**TABLE 1.** Selected Characteristics of SBO Patients by Prior Abdominal Surgery Groups, N = 601

Characteristic	No Prior Abdominal Surgery (n = 101 [16.8%])	Prior Abdominal Surgery (n = 500 [83.2%])	p
Operative exploration, n (%)	39 (38.6)	139 (27.8)	0.03
Age ≥65 y, n (%)	36 (35.6)	240 (48.0)	0.02
Female sex, n (%)	25 (24.8)	250 (50.0)	<0.01
Systolic blood pressure, mean (SD), mm Hg	137.4 (21.5)	135.9 (22.8)	0.53
Body mass index, mean (SD), kg/m <sup>2</sup>	27.3 (7.2)	27.3 (7.1)	0.94
Temperature, mean (SD), °C	38.4 (2.5)	37.0 (3.9)	0.26
Hemoglobin, mean (SD), g/dL	13.7 (2.5)	13.3 (2.3)	0.16
White blood count, mean (SD), ×10 <sup>9</sup> /L	10.6 (5.5)	10.3 (4.3)	0.60
Heart rate, mean (SD), beats/min	86.1 (18.1)	85.3 (17.3)	0.70
Respiration rate, mean (SD), breaths/min	19.0 (3.4)	18.1 (3.9)	0.02
History of cancer, n (%)	19 (18.8)	213 (42.6)	<0.01
History of Crohn disease, n (%)	5 (4.0)	12 (2.4)	0.26
Prior SBO admission, n (%)	9 (8.9)	206 (41.2)	<0.01
Prior SBO surgery, n (%)	0 (0.0)	109 (21.8)	<0.01
Surgical admission, n (%)	74 (73.3)	379 (75.8)	0.60
Intensive care unit admission, n (%)	16 (16.2)	58 (11.7)	0.28
Duration of obstruction, mean (SD), d	1.5 (2.0)	1.5 (2.1)	0.89
Perforation, n (%)	3 (3.0)	12 (2.4)	0.74
Readmission within 30 d, n (%)	13 (12.9)	70 (14.0)	0.76
GG use, n (%)	36 (35.6)	261 (52.2)	<0.01

strangulation, peritonitis, closed loop obstruction, or pneumatosis intestinalis. Our analysis compared operative exploration outcomes among four patient groups: (1) PAS undergoing GG challenge, (2) PAS undergoing operative exploration, (3) no PAS undergoing GG challenge, and (4) no PAS undergoing operative exploration.

Categorical variables were analyzed using Pearson  $\chi^2$  test; continuous variables were analyzed with the two-tailed, independent-samples *t* test. Logistic multivariable analysis was performed to compare our target group means after adjustment for differences in selected variables that were statistically significant or clinically relevant. Categorical variables were eligible for model inclusion only if minimum category sample size was 30 or more, to avoid skewing results with smaller numbers. The variables analyzed are included in Table 1. The discriminatory ability of the resulting model was measured by the area under the receiver operating characteristic curve (C statistic). Goodness of fit for the model was tested by the Hosmer-Lemeshow procedure. For all comparisons, two-sided *p* values were computed to assess significance of differences. Data were analyzed using StataMP 14 (Stata, College Station, TX). *p* < 0.05 was considered significant. The study was approved by the John Peter Smith Health Network Institutional Review Board.

## RESULTS

A total of 601 SBO patients were included in our analysis. Of these, 178 (29.6%) underwent operative exploration. Table 1 outlines PAS patients (n = 500 [83.2%]) and non-PAS (n = 101 [16.8%]) patients. Patients who had PAS were more likely to be 65 years or older, more likely to be female, and less likely to undergo operative exploration. In addition, they were more likely to have a history of cancer and to have been admitted previously for SBO. The administration of the GG challenge was

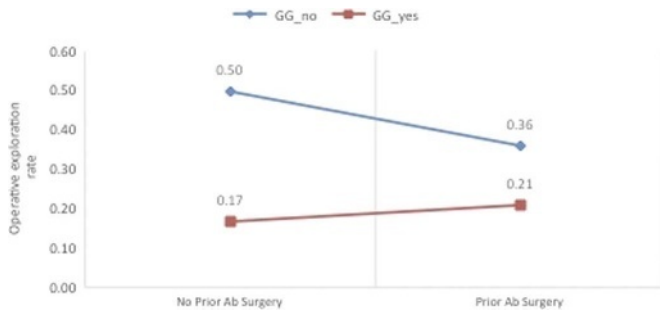
significantly higher in patients who had PAS than in those who did not (52.2% vs. 35.6%; *p* < 0.01).

Table 2 shows the model variables for predicting operative exploration. The model appears to represent an adequate fit of the data (*p* = 0.48) and a moderate level of discrimination (C = 0.78). Note the low *p* values for prior abdominal surgery (*p* = 0.04), GG (*p* < 0.01), and their interaction (*p* = 0.10) after adjustment by the other independent variables in the model. The overall odds for operative exploration were about 50% less (odds ratio [OR], 0.51) for those who had prior abdominal surgery than for those who did not. Also, the odds for operative exploration when GG was applied were about 85% less (OR, 0.14) than when GG was not applied.

Figure 1 shows the mean rates for the four combinations of GG and prior abdominal surgery along with the nonparallel lines that reflect moderate interaction. For patients who did not undergo the GG challenge test, the operative exploration rate was significantly lower when there had been prior abdominal

**TABLE 2.** Univariate and Multivariate ORs for Operative Exploration as Dependent Variable (n = 594)

Characteristic	Univariate OR (p)	Multivariate OR (p)
Prior abdominal surgery	0.61 (0.03)	0.51 (0.04)
GG use	0.29 (<0.01)	0.14 (<0.01)
Interaction (prior abdominal surgery by GG)	n/a	2.85 (0.10)
Age ≥65 y	1.11 (0.56)	0.87 (0.53)
Female sex	1.23 (0.24)	1.49 (0.07)
Hemoglobin	0.89 (<0.01)	0.93 (0.13)
Intensive care unit admission	16.44 (<0.01)	16.0 (<0.01)
Prior SBO admission	0.66 (0.03)	0.80 (0.33)
Surgical admission	1.42 (0.11)	2.34 (<0.01)



**Figure 1.** Comparison of adjusted operative exploration rates for patients with and without GG and prior abdominal surgery, N = 601.

surgery (0.36 vs. 0.50;  $p < 0.05$ ) compared with those without prior abdominal surgery. For patients who underwent the GG test, there was no difference in operative exploration rates between patients with PAS and those with PAS. Furthermore, of the 36 patients in the no PAS group who underwent the GG test, 33 were successfully treated nonoperatively. The remaining three underwent therapeutic laparotomy.

## DISCUSSION

Small bowel obstruction is a common clinical problem in the United States. In the United States, 15 of every 100 admissions for abdominal pain are related to a SBO.<sup>10</sup> This diagnosis constitutes 300,000 admissions annually and 20% of all acute surgical admissions.<sup>10</sup> The most common cause of SBO in industrialized countries is adhesive disease (65–75%), followed by malignancy and hernias.<sup>11</sup> This finding is in contrast to developing countries, where the primary etiologies are hernias (30–40%) and adhesive disease (30%), followed by tuberculosis or malignancy (10%).<sup>12</sup> Given the likelihood of adhesions is low in the virgin abdomen (i.e., no PAS), many argue that an SBO in this patient population mandates exploration in order to avoid missing a diagnosis of malignancy.<sup>2</sup> Although a reasonable concern, this study found that only 3 of the 101 patients with no PAS had a malignant SBO that was recognized during exploration. Hence, a reasonable approach to patients with no PAS treated conservatively includes subsequent elective evaluation for luminal lesions that may require resection. This tactic avoids an urgent surgery, allowing for a more methodical approach resulting in a concise treatment plan and definitive surgery at time of operation.

This study challenges the need for mandatory operative exploration; there is minimal evidence regarding patients without PAS and whether they can be observed. One of the concerns with operative exploration relates to cost of care for which there are limited studies evaluating the comparison between operative and nonoperative management. The only study to date looks at the cost in the Netherlands of adhesive SBO and found that the average cost of nonoperative management was \$2,700 versus \$19,000 in the operative group.<sup>13</sup> Our study demonstrates the need to further investigate and consider cost in the decision-making process when the indications for operation are not completely clear.

With the increased use of computed tomography (CT) imaging, the need for operative exploration to definitively diagnose SBO has decreased. Small bowel obstruction as a radiographic diagnosis continues to rise. Although there are certain findings

on CT that are more suggestive of SBO than others such as dilated proximal bowel loops, transition point, and fecalization, their correlation with need for operative exploration is inconsistent.<sup>14</sup> Therefore, CT findings alone do not mandate an operation.

Arising from multiple etiologies, SBO can present with a variety of clinical presentations. Initial evaluation focuses on differentiating patients who should undergo urgent exploration versus those who may undergo a safe trial of nonoperative management.<sup>15</sup> This decision has often relied on a history of prior abdominal surgery or signs and symptoms of intestinal strangulation in addition to CT scan findings. As demonstrated in this study, 16.8% of patients had no history of abdominal surgery, 8.9% of those had prior SBO admission, and only 38.6% of those went on to operative exploration in this study. A major factor contributing to the lower rate of operative exploration was the use of GG.

Conservative management of SBO focuses on the use of GG, which is a hyperosmotic oral contrast agent that can be used in diagnostic studies. Because of its properties, GG is used as both a diagnostic and therapeutic modality.<sup>3</sup> Recent literature suggests that the use of oral contrast agents in the management of adhesive SBO produced significantly lower rates of operative exploration, shorter duration of stay, similar complication rates, and equal efficacy in diagnostic capabilities.<sup>9</sup> Our study uses the same patient population, but focuses on the patients with a virgin abdomen and the rates of operative exploration in those who received GG versus those who did not. As demonstrated in Figure 1, even the patient group with no PAS showed a significant decrease in operative intervention from 50% to 17% when GG was used, which validated its benefit in that patient population. Moreover, there was no difference in 30-day readmission rates between the groups, suggesting nonoperative management was a safe approach and did not simply put off a surgery that was more imminent.

Despite numerous strengths of this study, limitations exist. The main limitation is due to the lack of randomization and blinding, therefore leading to selection bias. There were also variable levels of experience and overall comfort level in using GG among the many different surgeons and institutions involved in this study. The decisions to explore certain patients and observe others were up to the discretion of the surgeon on the case and were not part of the variables collected in the database. Another limitation is that the EAST database was not designed to review complications or recurrences after 30 days in the SBO group managed nonoperatively or pathologic abnormalities that were missed. One of the limitations of this database is that not all SBO cases could be included based on the fact that some patients get admitted to other services not participating in the trial. This is a universal challenge, yet our numbers are large enough to allow for reasonable comparisons. Furthermore, the database did document those patients admitted to the medicine service, suggesting that not all patients were excluded if they were admitted to medicine. Despite the limitations of this study, we believe that our results can significantly contribute to the literature in regard to management of SBO in the virgin abdomen.

## CONCLUSIONS

Patients with and without PAS showed lower rates of operative exploration for SBO with the administration of GG.

Patients with a virgin abdomen do not require urgent operative intervention, but rather may be considered for conservative (nonoperative) management with GG when no clinical evidence of intestinal strangulation or perforation exists.

#### AUTHORSHIP

M.L.C. wrote the first draft of the manuscript. T.M.D. and M.D.Z. developed the study design. M.D.R.-Z. and N.N.H. performed data generation. B.M., M.C.-F., T.M.D., and M.D.R.-Z. performed data analysis and interpretation. M.L.C., T.M.D., B.M., M.D.R.-Z., D.D.Y., and M.D.Z. wrote the manuscript.

#### DISCLOSURE

The authors declare no conflicts of interest.

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#### EDITORIAL CRITIQUE

The pendulum continues to swing toward non-operative management, and away from the proverbial “never let the sun rise or set on a small bowel obstruction”. The EAST multi-institutional SBO study group sought to evaluate whether the “so-called” virgin abdomen can be initially managed nonoperatively. It challenges the idea that those without prior abdominal surgery have higher risk for a malignant etiology or other catastrophic cause.

Prior studies evaluating non-operative management of SBO in the virgin abdomen have largely been single institutional studies, but all have supported the concept that a virgin abdomen can be managed successfully non-operatively especially with the aid of water-soluble contrast agents. This is the first multi-institutional study, albeit not the largest, attempting to demonstrate that patients without PAS can undergo non-operative management with non-inferior results when compared to patients with a past surgical history.

However, the observational design leaves several unknowns about surgical decision-making and disease recurrence. This should thereby give pause for the indiscriminate practice of conservative management. The low sample size of the study population, namely the patients without PAS who received GG, should deter the reader. This study serves to pique debate and discussion. It further supports accumulating evidence that de novo adhesive disease may in fact contribute to many cases of SBO in the patient without PAS. Ultimately, the management of these patients deserves further investigation with more robust research designs going forward.

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