A protocol for the management of adhesive small bowel obstruction

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Submitted: August 1, 2014, Revised: October 1, 2014, Accepted: October 3, 2014
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DOI: 10.1097/TA.0000000000000491

BACKGROUND: Differentiating between partial adhesive small bowel obstruction (aSBO) likely to resolve with medical management and complete obstruction requiring operative intervention remains elusive. We implemented a standardized protocol for the management of aSBO and reviewed our experience retrospectively.

METHODS: Patients with symptoms of aSBO were admitted for intravenous fluid resuscitation, bowel rest, nasogastric tube decompression, and abdominal examinations every 4 hours. Laboratory values and a computed tomography scan of the abdomen and pelvis with intravenous contrast were obtained. Patients with peritonitis or computed tomography scan findings suggesting bowel compromise were taken to the operating room for exploration following resuscitation. All other patients received 80 mL of Gastroview (GV) and 40 mL of sterile water via nasogastric tube. Abdominal plain films were obtained at 4, 8, 12, and 24 hours. If contrast did not reach the colon within 24 hours, then operative intervention was performed.

RESULTS: Over 1 year, 91 patients were admitted with aSBO. Sixty-three patients received GV, of whom 51% underwent surgery. Twenty-four patients went directly to the operating room because of clinical or imaging findings suggesting bowel ischemia. Average time to surgery was within 1 day for the no-GV group and 2 days for the GV group. Patients passing GV to the colon within 5 hours of administration had a 90% rate of resolution of obstruction. There was a direct relationship between the duration of time before passing GV to the colon and hospital length of stay (HLOS) ($r^2 = 0.459$). Patients who received GV and did not require surgery had lower HLOS (3 days vs. 11 days, $p < 0.0001$).

CONCLUSION: The GV protocol facilitated early recognition of complete obstruction. Administration of GV had diagnostic and therapeutic value and did not increase HLOS, morbidity, or mortality. (*J Trauma Acute Care Surg*. 2015;78: 13–21. Copyright © 2015 Wolters Kluwer Health, Inc. All rights reserved.)

LEVEL OF EVIDENCE: Therapeutic study, level V. Epidemiologic study, level V.

KEY WORDS: Adhesive small bowel obstruction; mechanical small bowel obstruction; Gastroview; Gastrografin; adhesiolysis.

Adhesive disease is the most frequently encountered disorder of the small intestine. In one review of 87 studies including 110,076 patients, the incidence of adhesive small bowel obstruction (aSBO) following all types of abdominal operations was 2.4%.[1] In North America, there are more than 300,000 annual hospital admissions for aSBO accounting for 850,000 days of inpatient care, costing more than $1.3 billion in medical expenditures and contributing to more than 2,000 deaths annually.[2]

A Nationwide Inpatient Sample study performed in 2009 enrolled 27,046 patients with aSBO and demonstrated that delay in surgery was associated with increased hospital length of stay (HLOS) and mortality.[3] Surgery was performed on 18% of all patients enrolled.[3] For this subgroup, 32% stayed in the hospital more than 1 week, 25% required bowel resection, 19% experienced a complication, and 3% died.[3] A delay in four or more days was associated with a 64% increase in mortality.[3] Finding nonviable bowel at the time of exploration was associated with a fourfold increase in mortality.[3] The imperative nature of early surgical intervention for aSBO was substantiated by a review of 9,297 patients from the National Surgical Quality Improvement Program from 2005 to 2011.[4] Keenan et al.[4] observed that patients who underwent surgery after a preoperative HLOS of 3 days had increased overall 30-day morbidity and that patients who received their operation after 4 days had increased total HLOS.[4] Consistent with these findings, a 2013 update of World Society of Emergency Surgery guidelines for the management of aSBO recommends that nonoperative management should not exceed 3 days.[5]

However, operative intervention is associated with significant risks including enterotomy, bowel resection with anastamotic complications, short bowel syndrome, prolonged ileus, hernia formation, and recurrent symptoms.[1,3,4] Because of the substantial operative risks associated with adhesiolysis, operative exploration is traditionally reserved for those afflicted with complete obstruction and those with evidence of bowel ischemia. Despite medical advances, differentiating between partial and complete obstruction remains difficult. The necessity for a standardized protocol-driven approach to managing aSBO with attention to early recognition of strangulation has been well articulated and part of the rationale for the development of such a protocol at our institution.[6]

Before adoption of water-soluble contrast administration strategies, some authors made the decision to operate based on a history of obstipation, the presence of mesenteric edema, and a lack of small bowel fecalization on computed tomography (CT) scan.[7–10] The presence of all three signs was found to have a positive predictive value of 90% for the necessity of surgical exploration.[7–9] One author found that clinical judgment had sensitivity of 48% in detecting strangulation in the preoperative setting,[10] whereas multiple reviews have concluded that CT is 84% to 100% sensitive for detecting ischemia and strangulation.[11–14]

MD-Gastroview (GV; Mallinckrodt, Inc., St. Louis, MO) is a water-soluble contrast agent that creates an osmotic gradient in the gastrointestinal lumen, which may transmit pressure across an obstruction.[15] The use of contrast agents to encourage resolution of partial aSBO has been effective in some studies but remains controversial.[15,16] Odds of resolution are improved if the contrast progresses to the colon within 24 hours.[7] Goussous et al.[7] compared the use of GV to historic controls and demonstrated an improvement in the resolution of partial obstruction while decreasing HLOS. With the implementation of such a protocol, our objectives were to identify complete obstruction early, resolve partial obstruction, operate within 3 days of admission when necessary, and decrease HLOS. We hypothesized that administration of GV would allow for early identification of complete bowel obstruction.

PATIENTS AND METHODS

Institutional review board approval was obtained for this case series. We reviewed patients admitted to our acute care surgery service from January 2013 to December 2013 with

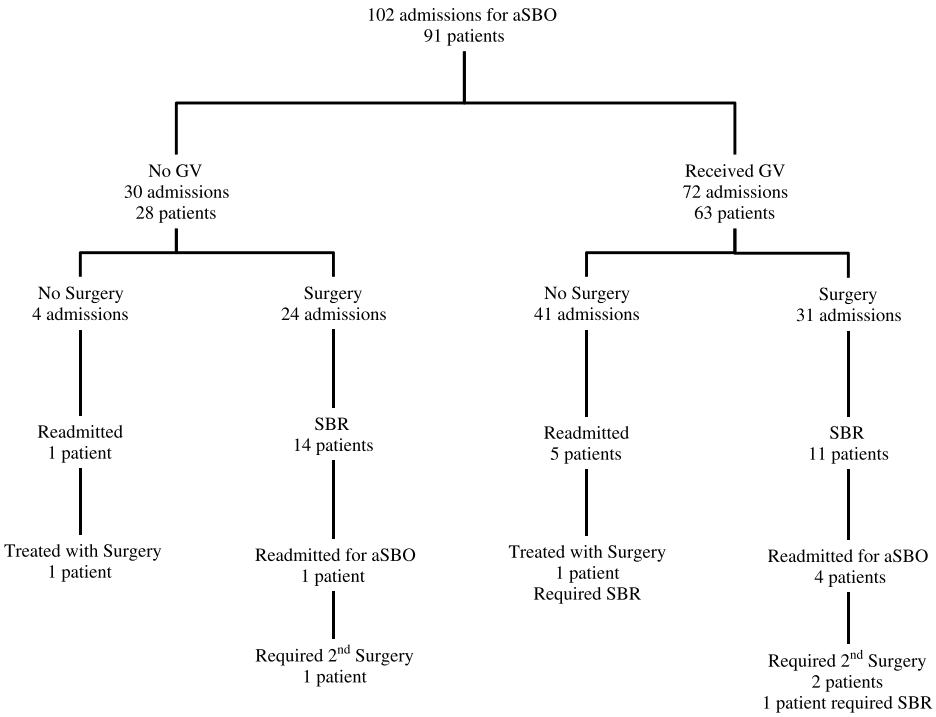

Figure 1. Patient algorithm.

symptoms of obstruction and suspicion for aSBO. Patients without a history of abdominal surgery were excluded. We implemented a standard-of-care protocol based on previously published literature.[3–5,7] Upon presentation to the emergency department, initial management included volume resuscitation with intravenous (IV) isotonic fluid administration and nasogastric tube (NGT) decompression. Laboratory data were obtained including complete blood cell count, basic metabolic panel, and lactate levels. Foley catheters were placed to monitor the resuscitation in patients not previously anuric due to end-stage renal disease. Patients presenting with symptoms of peritonitis or symptoms of ischemic bowel such as localized abdominal tenderness associated with fever, tachycardia, and leukocytosis underwent operative management as soon as they were adequately resuscitated. CT scan with IV contrast was obtained. If there were CT findings of mesenteric edema, pneumatosis, perforation, closed-loop obstruction, or swirl sign with free fluid, then the patient underwent operative exploration. In the absence of these signs, the patient was monitored with serial abdominal examinations. Complete blood cell count, basic metabolic panel, and lactate levels were assessed every 6 hours to closely follow the efficacy of the resuscitation as well as identify early progression of ischemia. Following gastric decompression overnight or for a minimum of 6 hours, the patient was evaluated for aspiration risk factors including paraesophageal hernia, hiatal hernia, chronic obstructive pulmonary disease, or other cause of pulmonary insufficiency requiring home oxygen therapy, age greater than 65 years, or advanced frailty as determined by the clinical judgment of the admitting team. Patients who presented bed bound, with limited independent functional status, or required assistance for primary activities of daily living were examples of those deemed frail. Patients who were not at increased risk for aspiration received 80-mL GV followed by 40-mL sterile water via NGT. The NGT was clamped following the administration of GV and remained clamped unless the patient developed nausea or increasing abdominal pain, at which time the NGT was returned to suction. Patients with increased aspiration

TABLE 1. Patient Characteristics

	GV, n = 72	No GV, n = 30	
	Mean (range) or n (%)	Mean (range) or n (%)	p ($\alpha = 0.05$)
Age	60.2 (21–96)	58.2 (22–91)	0.62
Male	28 (38.9)	11 (36.7)	0.53
History of ventral hernia	15 (20.8)	3 (10.0)	0.15
History of small bowel obstruction	26 (36.1)	13 (43.3)	0.54
Body mass index, kg/m^2	28.4 (12.5–53.2)	28.9 (16.3–68.0)	0.88
Heart rate	89 (52–142)	88 (57–140)	0.80
Systolic blood pressure	133 (89–178)	134 (90–193)	0.86
White blood cell count	10.3 (0.8–27.0)	10.3 (3.9–24.3)	
Serum creatinine	1.3 (0.1–12.9)	1.5 (0.5–11.5)	0.69
Lactic acid	1.5 (0.4–5.5)	1.4 (0.7–3.0)	0.61
Base deficit	3.7 (–9–18)	1.6 (–6–9)	0.19
Serum bicarbonate	24.7 (12.1–38.3)	24.6 (18.9–31.0)	0.84
CT, fecalization of small bowel	10 (13.9)	6 (20.0)	0.40
CT, free abdominal fluid	9 (12.5)	7 (23.3)	0.18
CT, bowel wall thickening	4 (5.6)	6 (20.0)	***<0.03***
CT, closed-loop obstruction	6 (8.3)	5 (16.7)	0.51
CT, mesenteric swirl	0 (0.0)	1 (3.3)	0.33

TABLE 2. Outcomes

Outcomes	GV + No Surgery (n = 41) Medians (IQR) or n (%)	GV + Surgery (n = 31)	No GV + Surgery (n = 26)	No GV + No Surgery (n = 4)
HLOS	3 (2–5) (***p* < 0.0001**)	11 (9–16)	9.5 (6.75–13.75) (***p* = 0.9999)	4.25 (3–5.25) (†*p* = 0.9999)
Time to colon, h	5 (0.5–18) (***p* < 0.0002**)	8 (5.8–12)	N/A	N/A
Time to surgery, d	N/A	2 (1–2)	0.5 (0–1.75) (***p* = 0.9996)	N/A
Mortality	0 (0%) (***p* = 0.0140**)	1 (2.9%) (‡*p* = 0.9143)	2 (5.8%) (***p* = 0.1276)	0 (0%) (°*p* = 0.0792)

*p annotates the comparison between the GV + No Surgery and GV + Surgery groups.
**p annotates the comparison between the GV + Surgery group and the No GV + Surgery group.
†p annotates the comparison between No GV + No Surgery group and GV + No Surgery group.
‡p annotates the comparison between the GV + Surgery group and all other groups.

risk underwent GV administration under fluoroscopy. Abdominal plain films were then taken 4, 8, 12, and 24 hours following contrast administration. The intervals for plain films were selected based on a physiologic small bowel transit time of 1 hour to 2 hours for emptying of 50% of small bowel contents[17] and were similar to those used for a radiology-driven protocol for a small bowel follow-through series, which was previously established at our institution. We collaborated with our radiology colleagues to ensure that a majority of the studies would be performed on the ward to prevent significant delays in contrast administration. The study was concluded when contrast reached the colon and the patient had a bowel movement. Increased abdominal pain, development of peritonitis, progressive nausea, worsening fever and leukocytosis, or failure to pass contrast to the colon after 24 hours were considered indications for surgery. If the patient's symptoms resolved before GV administration, the NGT was removed and a feeding challenge was performed.

This data were evaluated as a case series with Level V evidence. Categorical variables were reported as frequencies and percentages. Two-way analysis of variance and Bonferroni's multiple comparisons test were preformed when appropriate with a 0.05 α level to compare variables for significance among cohorts. Statistical analyses were performed using GraphPad Prism 6.00. Quantitative variables between two discrete groups were compared with Student's unpaired t tests. Data are presented as averages or medians with interquartile range (IQR) or percent as indicated.

RESULTS

Ninety-one patients presented with symptoms of aSBO for 102 total admissions. Sixty-two percent of all patients were female, and the average patient age was 60 years. Eighteen percent of all patients were found to have a ventral hernia, and 63% of these hernias were involved in the obstructive process. Patients with a ventral hernia that was involved in the obstructive process were noted to have a significantly higher body mass index than that of all other patients (35.7 vs. 27.4, $p < 0.05$). One patient was excluded from the data analysis. This patient was admitted for lung transplantation, underwent multiple operations over a 5-month hospital stay, and eventually developed multiple organ system failure. The family elected to withdraw care.

We observed a 99% rate of compliance to the protocol. Twenty-eight patients did not receive GV (Fig. 1). Four of these patients had resolution of obstruction following bowel rest, nasogastric decompression, and IV fluid hydration before the administration of GV. One of these four patients required readmission and adhesiolysis without bowel resection. The other 24 patients who did not receive GV underwent surgery, and 14 of these patients (58%) required small bowel resection (SBR). One of these patients had recurrence of aSBO within 1 month, was readmitted, and underwent adhesiolysis.

Of the 72 patient admissions directed into GV challenge group, 41 (57%) resulted in GV passage to the colon with resolution of obstructive symptoms without surgical intervention (Fig. 1). Five patients (7%) who were discharged after initially passing the GV challenge required readmission. Four of these patients were treated again with GV challenge with resolution of obstruction, and the remaining one patient underwent adhesiolysis and SBR. Thirty-one patient admissions (43%) resulted in failure to pass GV to the colon and were therefore considered to have failed the challenge. In each of the 31 cases of failure to pass the GV challenge, adhesiolysis was performed. Eleven (33%) of these operations included SBR.

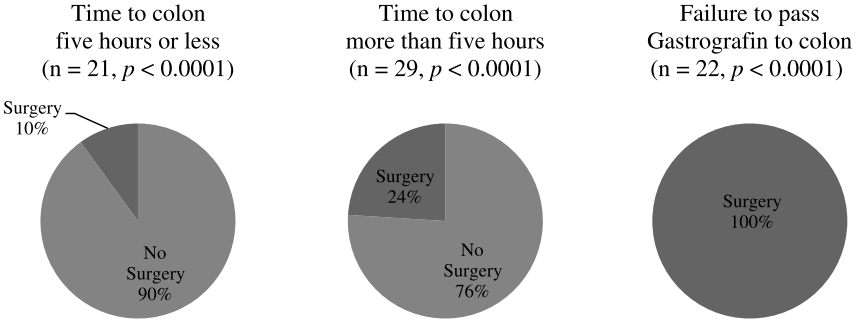

Figure 2. Association between GV progression and operative intervention.

Four patients in this group were readmitted with recurrent aSBO, and two of these patients required a second surgery.

No statistically significant difference was identified for the age, sex, history of ventral hernia, history of small bowel obstruction, or body mass index for the GV group as compared with the no-GV group (Table 1). Patients who did not receive GV were more likely to have CT scan findings of bowel wall thickening (20% vs. 5.6%, $p < 0.03$). All other CT findings were not significantly different between the groups. Admission white blood cell, creatinine, lactate, base deficit, or bicarbonate levels were also similar between the groups. Patients who underwent SBR presented with higher heart rates (91 [IQR, 80–101] vs. 83.5 [IQR 70–28], $p < 0.0450$) and lower blood pressures (128.5 [IQR, 112–140] vs. 136.5 [IQR, 121–152], $p < 0.0007$) than those of patients who did not undergo SBR.

As demonstrated in Table 2, patients who received GV and did not require surgery had lower HLOS (3 days [IQR, 2–5] vs. 11 days [IQR, 9–16], $p < 0.0001$), faster passage of contrast into the colon (5 hours [IQR, 0.5–18] vs. 8 hours [IQR, 5.8–12], $p < 0.0002$), and lower mortality (0%, $p < 0.0140$). Patients undergoing SBR had an increased HLOS than patients who had surgery without SBR (9.3 days vs. 6.1 days, $p < 0.0001$). Patients in the GV group had significantly lower rates of operation (47% vs. 86%, $p < 0.01$) and SBR (31% vs. 56%, $p < 0.04$) as compared with the no-GV group.

The relationship between GV progression to the colon and the need for surgical intervention was significant (Fig. 2). The presence of GV in the colon less than 5 hours following administration resulted in a 90% rate of resolution of obstruction (n = 19 of 21, $p < 0.0001$). Seven of the patients who had progression of GV to the colon after 5 hours (24%) failed clinically with feeding intolerance, fever, leukocytosis, and/or physical signs of peritonitis and therefore required surgical intervention (n = 7 of 29, $p < 0.0001$).

There was a direct relationship between the duration of time before passing GV to the colon and overall HLOS ($r^2 = 0.459$) (Fig. 3). Seven patients underwent an operation 3 days or more after admission (Fig. 4). These patients had a statistically significant increase in bowel resection rate (78%) compared with patients undergoing surgery within 3 days of admission (38%) ($p < 0.03$). One of these patients was allowed to progress without an operation because of operative risks associated with ventilator dependence

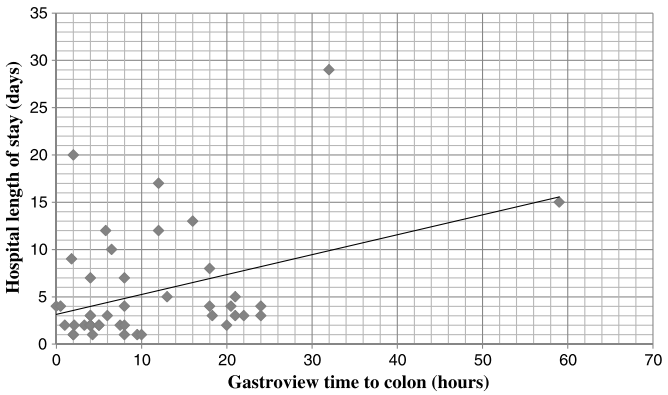

Figure 3. The duration of time before passing GV to the colon versus overall HLOS.

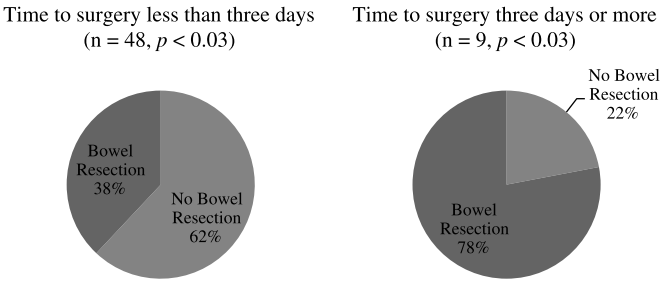

Figure 4. Time to surgery versus bowel resection rates.

and sepsis secondary to pneumonia, and one patient initially failed to pass GV from the stomach to the duodenum, and EGD identified a gastric ulcer. This patient passed GV to the colon after this procedure was performed.

Patients who were readmitted with recurrent aSBO had been discharged after an initial average HLOS of 4.3 days. The average time to readmission was 47.8 days. Forty-five percent of these patients required adhesiolysis, and 60% of these operations included bowel resection. There were three mortalities in our series. One death was caused by non-ST elevation myocardial infarction in a patient who underwent surgery without bowel resection after presenting with peritonitis. The second death occurred following withdrawal of care for a patient with postoperative dependence on mechanical ventilation via tracheostomy in the context of multiple myeloma and preoperative life expectancy of less than 1 year. This patient underwent surgery with resection of bowel involved in a closed-loop obstruction on the day of admission. A third death occurred in a patient who initially passed GV into the colon and then developed recurrent symptoms of obstruction and underwent surgery with bowel resection on hospital Day 4. This patient also had a preoperative life expectancy of less than 1 year because of metastatic bladder cancer and developed multiple organ system failure, and the family elected to withdraw care. None of the deaths were attributable to the operative procedure itself. There were no aspirations or other adverse events related to the administration of GV.

DISCUSSION

Clinical outcomes for patients presenting with aSBO are largely dependent on early operative intervention for patients who fail to resolve with medical management.[3–5] Quickly and accurately identifying this group of patients is a difficult task. Signs and symptoms of compromised perfusion of the small bowel including continuous abdominal pain, fever, leukocytosis, tachycardia, signs of peritoneal irritation, hyperamylasemia, and metabolic acidosis are not reliable for diagnosing intestinal ischemia or complete bowel obstruction.[10] Our goal was to initiate a standardized protocol designed for early differentiation between partial and complete bowel obstruction. Our data suggest that GV may be safely administered to patients presenting with aSBO and facilitates early identification of patients with a high likelihood of failing medical management.

Of all hemodynamic, laboratory, and imaging metrics measured, the only factor that was associated with the need for urgent operation was bowel wall thickening on CT scan. CT

scan findings of closed-loop obstruction and mesenteric swirl were infrequently identified and inconsistently reported. Our protocol was successful in facilitating operative intervention within 72 hours of admission, consistent with contemporary recommendations for early surgical management.[5–7] The difference in time to operation from 2.0 days for patients receiving GV to 0.5 days for patients not receiving GV is likely caused by the fact that all patients with peritonitis on examination or CT scan findings consistent with bowel compromise underwent an operation immediately following volume resuscitation and did not receive GV.

Administration of GV provided substantial prognostic information. Only 1 of 10 patients passing GV to the colon within 5 hours of administration required surgical management during that admission. In comparison, 24% of patients passing GV to the colon after a period of 5 hours required an operation. The decision to operate on patients who had passed GV to the colon was based on worsening abdominal pain, recurrent symptoms with feeding challenge, or fever and leukocytosis, as established in published literature.[5] The duration of time before passing GV to the colon was directly proportional to overall HLOS, as would be expected for the natural history of this disease process. In our experience, patients underwent urgent operation when clinical or radiographic signs of peritonitis or bowel ischemia were evident and were not typically delayed by a lack of attending availability, operating room availability, or time of the day. Previously described risks associated with water-soluble contrast administration include aspiration and anaphylactoid reactions, which are likely caused by flavoring agents and preservatives in the contrast solution.[18–20] However, there were no aspiration or anaphylactoid events in our series. Upon review of the patients who were readmitted with recurrent aSBO, it does not seem that these patients had been discharged prematurely as the average time to readmission was more than 1 month.

Previous studies have had similar results. A systematic review of 14 prospective trials found that the presence of contrast in the colon predicted resolution of the obstruction with 96% sensitivity, 98% specificity, 99% positive predictive value, and 90% negative predictive value. These values were unaffected by the duration of time before the appearance of contrast in the colon, and the authors concluded that there is no diagnostic advantage in waiting longer than 8 hours for contrast to reach the colon.[21] Nonoperative management has been endorsed for patients with no persistent vomiting, peritonitis, or CT scan findings of free fluid, mesenteric edema, devascularized bowel, or lack of feces sign with the caveat that nonoperative management should be discontinued if the patient becomes febrile with leukocytosis greater than 15,000/μL.[5]

A review of our data compared with previous trials demonstrates higher operative rates, bowel resection rates, and length of stay compared with other institutions.[22–28] One possible explanation is that we excluded only one patient admission of 103 admissions in 2013 and therefore included patients with bowel obstruction in conjunction with other acute medical and surgical conditions, which were often excluded from previous studies. The rationale for this approach was to improve the generalizability of our findings. We also observed that a substantial proportion of our patient population had ventral hernias and that most of these hernias were involved in the obstructive process in conjunction with adhesive disease. Data regarding these phenomena are not consistently available in the studies used for comparison.

Our HLOS may be affected by the fact that open surgery is the standard approach to operative management of aSBO at our institution as opposed to laparoscopy. A laparoscopic approach to adhesiolysis may be appropriate for patients with mild abdominal distension, proximal obstruction, partial obstruction, and obstructions that seem to be caused by a single adhesive band.[29] Potential advantages of a laparoscopic approach include an earlier return of bowel function as well as a decrease in wound complications, postoperative pain, length of stay, time to return to full activity, and postoperative adhesion formation.[30,31] A National Inpatient Sample of 6,165 patients concluded that there was a significant decrease in postoperative complications, HLOS, and overall costs for cases of aSBO managed with laparoscopic adhesiolysis.[32] In this study, 11.4% of patients underwent laparoscopic lysis of adhesions, with a 17.2% rate of conversion to open surgery.[32] Although prospective randomized control trials are needed to assess the role of laparoscopic management of adhesive bowel obstruction, it seems that this approach is safe and effective for a select patient population.

Application of a standardized protocol for the management of aSBO at our institution facilitated early recognition of complete obstruction. Administration of GV had both diagnostic and therapeutic value and did not increase HLOS, morbidity, or mortality. Consistent with established recommendations,[21,29–32] we plan to modify this protocol to encourage earlier intervention and laparoscopic adhesiolysis when appropriate. Patients who fail to pass GV to the colon after 8 hours will be examined and reassessed by the attending surgeon and/or chief resident. These modifications could create an effective platform for a prospective trial to establish the efficacy of this protocol as compared with traditional management.

AUTHORSHIP

T.L. contributed to the data collection, statistical analysis, data interpretation, manuscript writing, and manuscript revision. F.M. contributed to the study design, data interpretation, manuscript revision, and final approval. E.V. contributed to the statistical analysis. T.B. contributed to the data collection. S.B., C.C., L.L., W.R., D.M., L.A, and A.M. contributed to the study design, manuscript revision, and final approval. J.J. contributed to the study design, data collection, statistical analysis, data interpretation, manuscript writing, manuscript revision, and final approval.

DISCLOSURE

The authors declare no conflicts of interest.

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DISCUSSION

Dr. Clay Cothren Burlew (Denver, Colorado): I find the idea of a clear protocol for the management of a patient presenting with symptoms of a small bowel obstruction incredibly appealing. In patients without overt clinical signs mandating urgent operative intervention, these cases are often fraught with indecision, questions of timing for intervention, and whether or not clinical resolution has ever really been met. The classic "grey zone" in surgery. Therefore, I applaud the authors for implementing a previously developed guideline, and evaluating the results for our benefit. Moreover, they report a 99% compliance rate with the protocol, an impressive feat, in my opinion, for any group of clinicians.

That said, I would encourage the authors to share with us more of their data and experience. As you reported, the laboratory parameters such as the white count, lactate and base deficit as well as the majority of CT scan findings, aside from bowel wall thickening, were similar between the two groups. What was the indication for urgent operation in the 24 patients versus administration of Gastroview?

For those undergoing the Gastroview protocol, I gather that the protocol mandates that the patient will get an operation at 24 hours if there is no contrast in the colon. Why not simply check one abdominal film at the 24-hour mark to determine if the patient needs surgery? Why bother with the 4-, 8- and 12-hour films? Wouldn't this help in your cost containment? Similarly, as described in the manuscript, I find it interesting that you administer the Gastroview under fluoroscopy in high-risk aspiration patients. Perhaps you could comment on this choice, particularly with an average age of 60 in your population. I presume there is a significant number of patients that would meet the 65 or older target and require a trip to radiology

for fluoroscopy for administration of Gastroview and completion of the protocol.

In a similar vein of cost containment, did checking lab values every six hours, including a basic metabolic panel and lactate, actually alter your management? And if so, in how many patients? Or perhaps phrased in a different way, was the decision to operate in the 31 failures based on clinical parameters or was it based on failure to pass Gastroview to the colon?

Finally, for the seven patients with surgery greater than three days after admission, did these patients initially pass the Gastroview challenge, fail clinically, or did the attending surgeon simply not follow the protocol?

With 43% of your Gastroview group undergoing operative intervention at the time of laparotomy, were you happy with your protocol? What did you find at operation in the 66% of patients that did not require a bowel resection? Was the operation that was mandated by your protocol actually therapeutic?

Finally, with an average BMI of 28 in your study population, you have now convinced me to move to Gainesville for the remainder of my surgical career to operate on Floridians. I would like to thank the Association for the privilege of discussing this manuscript.

Dr. Martin Schreiber (Portland, Oregon): I'm curious, instead of doing a CT scan without enteral contrast and then doing an upper GI, why not just do the CT with enteral contrast and then do your follow-up x-rays to see if the contrast reaches the colon? Skip a step, save lots of money.

Dr. Martin Zielinski (Rochester, Minnesota): I'd like to applaud you for amending our small bowel obstruction management protocol for your institution. I think the Gastrografin challenge remains the definitely the way forward for small bowel obstruction treatment.

One of my questions, though, is the duration of stay in your Gastrografin group at three days. Are you pushing the protocol to its fullest extent?

At our institution we're starting a Gastrografin challenge protocol to be implemented in the emergency department. We hope to never admit the patients to the hospital but, rather, their course of treatment will remain in the observation unit. If they need an operation then they will be admitted and undergo the standard management at that point.

In order to be successful to do that, though, you can't have any missed strangulation obstructions in the Gastrografin challenge arm. Did you have any?

Dr. Ronald V. Maier (Seattle, Washington): I applaud you for the attempts to protocolize care for this disease which, after 100 years of modern medicine, still has no standard approach because it is not an easy disease to treat.

Two issues for your comment. A major problem is that complete SBO is a very difficult diagnosis to make. We know, from many studies, that 85% of patients go home without an operation and do fine. The challenge is to identify the 15% who will ultimately need an operation. But, using your protocol you will operate on nearly half of all patients, including a lot of patients whom, in retrospect, if you did nothing would go home with no operation and do fine.

It appears that you propose doing a lot of operations that previously were avoided by just observing patients for five days and avoiding an operation. Please comment. How many negative or ultimately unnecessary laparotomies are acceptable to avoid complications from excessive observation?

Secondly, in your protocol one indicator was pneumatosis for mandated immediate operation. Yet, if you look at the literature 60–70% of people with pneumatosis go on to resolve and don't require an operation. If you operate on all patients with pneumatosis, 70% of them would avoid surgery if you observe them.

We must be very careful in proposing laparotomies unless the risk of complication is significant. An unnecessary laparotomy carries a potentially significant price for the patient.

As was previously pointed out in our patient population with an average BMI of 50, a negative laparotomy in a diabetic with an albumin of 2.0 is not a minor event and carries significant risk of morbidity.

Dr. Janeen R. Jordan (Gainesville, Florida): In terms of cost containment and why we chose 4-, 8-, 12-, and 24-hour films, we were trying to negotiate with the radiologists so we kind of kept to their [schedule].

I think giving the PO contrast at the original CT is an interesting idea. Getting the films post-op would actually help, to some degree.

In our ER, when they give PO contrast, they tend to wait four hours before sending patients to the scanner. We didn't want that kind of delay, which is why we wanted an early diagnosis with the IV contrast. This allowed us to see whether or not they had true evidence of bowel ischemia.

Why do we send patients that we thought were high risk to fluoro for concern for aspiration? It actually ended up being a very small amount of patients, in retrospect. We had written the protocol because we do have an elderly population; it's Florida.

So there are a decent amount of people who come in and are frail or COPD patients on homo and so forth, so we wanted to not contribute to their complications by monitoring their contrast administration. We actually don't send very many people down. The residents are doing it safely on the floor per our protocol.

Regarding the lab values, there were a couple of people who had an increase in their leukocytosis that just gave us a little bit of a heightened sense of awareness but, again, it was a minor part of the patient population so I will go back and reevaluate whether or not we need to do them at those specific time points because you're right. We probably don't.

The patients who went to the operating room after that three-day period tended to be more complicated. So they either had comorbids where we were kind of trying to not operate on them as much as possible, which is what happens with this disease quite frequently, or the big problem I identified was that in the super morbidly obese we had plenty that were I think the patients who were associated ventral hernias with the obstruction the average BMI on that patient population was 36.

And so the contrast was actually hard to read. Sometimes we would re-dose it, actually, and start the protocol over. And so it took a little bit longer for those patients to get through. What I plan to do about those patients is actually go talk to the radiologist and look at our contrast and see if we need to dilute it or not or see if there is something else I

can do to try to make that more effective in that patient population. And that was the vast majority of those people.

Overall I do think we are happy with the protocol. I think our operative intervention and our bowel resection rate was higher at the beginning of the protocol than it is today. And so we are getting better about managing these patients. Just as Dr. Maier says, most of these patients can be managed nonoperatively and it's really about defining those few that actually require it.

Thus far we have not had any negative laparotomies. Everybody, so far, has had a transition point and improved, relatively speaking, except for the ones who actually ended up coming back and having recurrent disease.

So it is something that we are trying to consider and really define who needs the surgery and who doesn't. The contrast administration has actually been very helpful for that.

The indications to actually get to the operating room without going on to the contrast are correlative with the clinical exam. So it is not pneumatosis by itself that we are operating on. It is pneumatosis with peritonitis, really.

I would say that across the board none of them individually says you have to go. That's why I was trying to say that they were evaluated for operative intervention instead of we absolutely took them on because there have been a couple of patients with pneumatosis or with free fluid that we don't operate on.

And actually our radiology department overcalls closed loop obstructions every day. I would say 50% of the CT scans have a suggestion of a closed loop and we give them the Gastrografin and it goes right through and their symptoms completely resolve.

It's in correlation with a clinical exam that gets them straight to the operating room, not just the findings in and of themselves.

Dr. Zielinski, our ER is constantly full; they actually don't observe patients down there very well. So we admit the patients and get them upstairs and get them resuscitated much faster, much more effectively than if we tried to leave them in the ER and observe them and treat them without a hospital admission.

Even if we have to house them for 24 hours, if they have resolution of their symptoms without getting the contrast, that's probably better than leaving them down in our ER.

Thank for your time. I appreciate it.