

Clinical and CT-Guided Decision Making in Adhesive Small Bowel Obstruction: A Single-Center Prospective Study

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Abstract: Background: Adhesive small bowel obstruction (ASBO) is one of the common causes of readmission after any abdominal surgery in adults. While current guidelines suggest an initial conservative management trial, the value of computed tomography (CT) findings to predict the failure of nonoperative treatment is still unclear. **Methods:** This prospective, single-center cohort study included 41 adult patients with ASBO. All patients underwent standardized clinical assessment, CT imaging, and initial conservative management unless immediate surgery was indicated. CT variables, including mesenteric edema, small bowel feces sign, and intraperitoneal free fluid, were recorded. The outcomes of interest were the success or failure of conservative therapy, the need for surgery, intraoperative adhesion grade according to the Zühlke classification, postoperative complications, and length of hospital stay. **Results:** 30 patients (73.2%) were treated conservatively and 11 patients (26.8%) had early surgery. A total of 17 patients (41.5%) had to be operated on after the initial period of conservative treatment, and this was successful in 13 (31.7%). Mesenteric edema, small-bowel feces sign and intraperitoneal free fluid were not significantly associated with failure of conservative management or need for surgery in classical CT. Mean hospital stay was less in the patients in whom conservative treatment was successful than in the patients who underwent surgery. The predominant intraoperative adhesions were localized and single band, especially following midline laparotomy and laparotomy of the pelvis, while postoperative complications (mainly wound infection and pneumonia) were found in a significant number of the surgical patients. **Conclusion:** In this prospective cohort of patients with ASBO, commonly evaluated CT features were not useful for predicting the failure of conservative management and/or the need for surgery. Most patients eventually require surgical treatment after a period of nonoperative treatment, with considerable morbidity. This study suggests a multicenter approach with quantitative radiological scoring systems to define the optimal timing of surgery for ASBO and the pitfalls of CT-based decision-making.

Keywords: Abdominal adhesions, Adhesive small bowel obstruction (ASBO), Nonoperative therapy, Surgical management, CT scan indicators, Mesenteric edema, Intraoperative adhesion classification.

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INTRODUCTION

Although there have been significant improvements in surgical techniques, perioperative management, and care, adhesion remains a leading cause of morbidity and health service costs, and pharmacologic and technical means of adhesion prevention have been demonstrated with limited success [1,2].

Traditionally, nonoperative management is attempted for up to 72 hours, after which surgical management is attempted, as the nonoperative approach fails in approximately 30–40% of cases, according to the Bologna guidelines for the diagnosis and management of adhesive small bowel obstruction (ASBO) [3]. However, a significant proportion of these patients require surgery. This is not to deny that the timing of surgical intervention is controversial [3-5].

There are also classifications of ASBOs that indicate the heterogeneity of adhesions and different clinical behaviors. Adhesions may be total or partial and early or late, depending on whether they are obstructive [6,7]. Treatment is based on clinical and radiologic assessment, and up to 3/4 of small bowel obstruction presentations are conservatively treated. When symptoms do not improve after conservative treatment, surgery is necessary.

CT is the most important imaging modality for ASBO and has been used to assess different findings, including mesenteric edema, small-bowel feces sign, bowel dilatation, and free intraperitoneal fluid; however, the results of different studies have been discordant, and no agreement has been reached on which combination of these findings is most indicative of the likelihood of conservative failure or the need for surgery [3]. The relationship between the severity of adhesions at surgery, as classified by different scoring systems, such as the Zühlke system, and the history of a previous laparotomy is also poorly defined, which hinders the ability to accurately plan surgery and risk stratify [8].

Currently, there is a need for prospective, standardized datasets that include clinical presentation, quantitative CT assessment, and surgical findings to enable the development of validated and reproducible scoring systems for ASBO [9,10].

This prospective single-center study aimed to bridge these gaps by investigating the relationship between clinical and computed tomography (CT) features (mesenteric edema, constipation, and the presence or absence of small bowel feces sign) and the clinical outcomes of conservative and surgical management in patients with ASBO. This study also aimed to classify intraoperative adhesions according to Zühlke's system and to analyze postoperative complications with regard to the grades of adhesion.

MATERIALS AND METHODS

This single-center prospective cohort investigation was conducted at the Department of General Surgery, Division of Surgical Gastroenterology, Department of Obstetrics and Gynecology, and Department of Surgical Oncology. A total of 41 participants were enrolled in the study following informed and written consent and approval from the institution's ethics committee. The study was conducted over 18 months. Participants who provided written consent and were willing to participate, with a history of abdominal surgery (including colorectal, gynecological, and pediatric surgeries), were included. Exclusion criteria included those with small bowel obstruction that were not due to adhesions (no prior surgical history) and those < 18

years of age. The key parameters of the study included sex, age, comorbidities, presenting symptoms (abdominal pain, vomiting, abdominal distension, constipation, and/or upper abdominal feces sign), type of previous surgical history (upper abdominal, pelvic, midline laparotomy, laparoscopic), CT findings (mesenteric edema, small bowel feces sign, and free intraperitoneal fluid), duration of conservative treatment attempts, failure of conservative management, type of surgery (open/laparoscopic), grade of adhesions during the procedure, postoperative complications, and overall length of hospital stay. Patients were identified who had a diagnosis of ASBO, symptoms duration, previous surgical history, CT scan results, follow-up for conservative management or surgical intervention, analysis of successful or failed conservative management, and need for surgical intervention or adhesion grading by Zühlke *et al.* [8] were collected and analyzed.

Statistical Analysis

IBM Corp SPSS version 23 was used for statistical analysis. Descriptive statistics were used to describe the baseline characteristics. Data for categorical variables are reported as frequencies and percentages; data for continuous variables as mean and standard deviation (SD). Chi-square test was used for comparing categorical variables as it is appropriate for frequencies. Normality was assessed for continuous variables and t-test or one-way analysis of variance (ANOVA) was used for comparison of means between groups as appropriate. P-values < 0.05 were considered significant. Chi-square tests were used to evaluate the association between computed tomography (CT) scan findings and the need for surgical interventions. Logistic regression analysis was used to assess the ability of CT findings to predict the need for surgery.

RESULTS

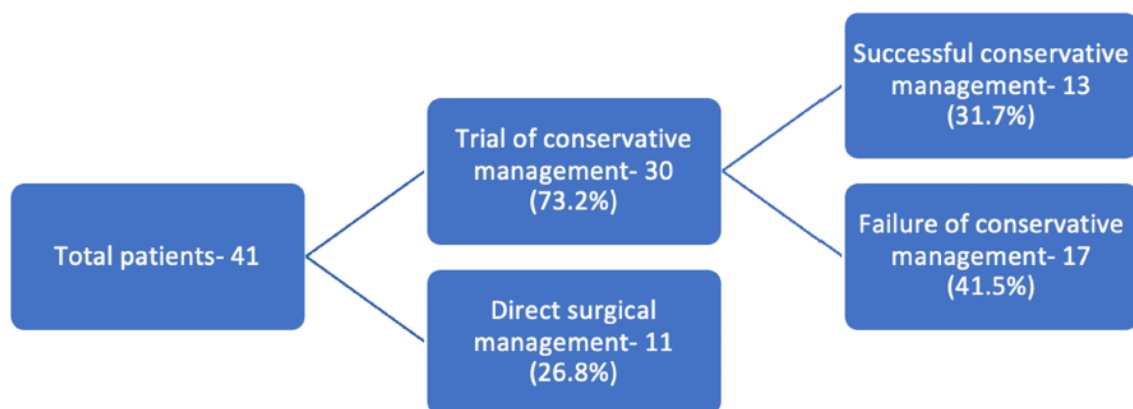
Baseline characteristics

Forty-one patients with adhesive small bowel obstruction were included in this study. Most patients were older than 50 years, and just over half were women (22/41, 53.7%). Abdominal pain (34/41, 82.9%) and vomiting (30/41, 73.2%) were the most common presenting symptoms, whereas abdominal distension, obstipation, and fever were less frequent. Comorbidities were present in 22 patients (53.7% of the total). Pelvic and midline laparotomies were the most common previous operations, whereas upper abdominal and laparoscopic procedures were reported less frequently. On CT, mesenteric edema, small-bowel feces sign, and free intraperitoneal fluid were observed in approximately one-quarter to one-third of the patients (26.8%, 31.7%, and 29.3%, respectively) (Table 1).



Table 1. Baseline demographic, clinical, surgical, and CT characteristics

Variable	Category	Frequency (n)	Percentage (%)
Sex	Female	22	53.7
	Male	19	46.3
Age group (years)	≤30	5	12.2
	31–50	14	34.1
	51–70	17	41.5
	≥70	5	12.2
Presenting complaint	Abdominal pain	34	82.9
	Abdominal distension	9	22.0
	Vomiting	30	73.2
	Obstipation	6	14.6
	Fever	9	22.0
Comorbidity	Yes	22	53.7
	No	19	46.3
Past surgery	Upper abdominal	4	9.8
	Pelvic	17	43.9
	Midline laparotomy	17	41.5
	Laparoscopic	3	7.3
CT finding	Mesenteric edema	11	26.8
	Small bowel feces sign	13	31.7
	Free intraperitoneal fluid	12	29.3

**Figure 1: Management of patients****Management pathways and operative findings**

An initial conservative approach was used in 30 patients (73.2%), whereas 11 patients (26.8%) underwent surgery based on clinical assessment. Of those managed conservatively, 13 patients (31.7% of the entire cohort) improved without surgery, but 17 (41.5%) ultimately required delayed surgery; thus, 28 patients underwent an operative procedure. (Figure 1)

Open laparotomy was the main surgical approach (23/28, 82.1%), with only a few purely laparoscopic procedures (3/28, 10.7%) and a small number converted from laparoscopy to open (2/28, 7.1%). Adhesiolysis was the most operation (19/28, 67.8%), while perforation repair and resection with anastomosis were performed less often (7.14% and 25.0%, respectively), usually in the setting of gangrenous or clearly ischemic bowel (Table 2).

Table 2. Operative characteristics, adhesion grades, complications, and hospital stay

Domain	Category	Frequency (n)	Percentage (%)
Surgical approach	Laparoscopic	3	10.7
	Laparoscopic → open	2	7.1
	Open	23	82.1
Procedure type	Adhesiolysis	19	67.8



	Perforation repair	2	7.14
	Resection and anastomosis	7	25.0
Adhesion grade	Grade 1	5	17.9
	Grade 2	15	53.6
	Grade 3	7	25.0
	Grade 4	1	3.6
Postoperative complication	None	16	57.1
	Wound infection	6	21.4
	Pneumonia	5	17.9
	Pneumonia + wound infection	1	3.6
Hospital stay (days)	4–10	23	56.1
	11–15	12	29.3
	>15	6	14.6

Adhesion grading and relationship to prior surgery

Intraoperative grading revealed that most patients had moderate adhesions. Grade 2 adhesions were recorded in 15 patients (53.6%) and grade 3 in seven (25.0%), whereas grade 1 and grade 4 adhesions were less frequent (17.9% and 3.6%, respectively) (Table 2). When adhesion grade was compared with the type of previous operation (upper abdominal, pelvic, midline laparotomy, laparoscopic), no significant relationship emerged for any category (all $p > 0.05$; Table 4)

Postoperative complications and length of stay

Postoperative complications occurred in 12 of the 28 patients (42.9%). Wound infection (6/28, 21.4%) and pneumonia (5/28, 17.9%) were the most frequent problems, and one patient (3.6%) developed both pneumonia and wound infections. The remaining 16 patients (57.1%) had an uncomplicated postoperative course (Table 2).

Hospital stay for the entire cohort most often fell in the 4–10 day range (23/41, 56.1%). A further 12 patients

(29.3%) stayed 11–15 days, and 6 (14.6%) remained in hospital for more than 15 days (Table 2).

Factors associated with conservative and surgical outcomes

Univariate analyses were used to explore the factors associated with the outcomes. For patients initially managed conservatively, none of the baseline clinical features (sex, age, symptoms, and comorbidities), CT findings (mesenteric edema, small bowel feces sign, and free intraperitoneal fluid), adhesion grade, or total duration of stay showed a significant association with overall conservative success or failure (all $p > 0.05$). In the surgically treated group, the same variables were largely non-discriminatory; only the total hospital stay differed significantly between outcome categories ($p = 0.006$). When the subgroup with successful conservative management was examined separately, the pattern was similar, with no clear clinical or CT predictor of success, while the hospital stay differed significantly ($p = 0.002$). The p -values are presented in a single summary table (Table 3).

Table 3. Univariable analysis of factors associated with conservative and surgical outcomes

Variable	Conservative outcome p-value	Surgical outcome p-value	Successful conservative p-value
Sex	0.438	0.184	0.269
Age (years)	0.332	0.840	0.835
Abdominal pain	0.411	0.112	0.197
Abdominal distension	0.724	0.353	0.400
Vomiting	0.449	0.698	0.936
Obstipation	0.543	0.926	0.869
Fever	-	0.489	0.773
Comorbidity	0.524	0.511	0.310
CT mesenteric edema	0.969	0.712	0.697
CT small bowel feces sign	0.252	0.418	0.697
CT free intraperitoneal fluid	0.168	0.553	0.977
Adhesion grade	0.500	-	-
Total duration of stay (days)	0.169	0.006*	0.002*



The length of the conservative trial itself showed a trend that did not reach conventional significance. Among patients observed for five days or less, four (30.8%) improved without surgery, and 11 (64.7%) ultimately required surgery. In contrast, among those observed for more than five days, nine (69.2%) had

successful conservative treatment, and six (35.3%) failed ($p = 0.07$). Given the sample size, this suggests, but does not prove, that a longer conservative trial may be associated with better nonoperative outcomes in carefully selected patients.

Table 4. Relationship between adhesion grade and previous surgical approach

Previous surgery	Grade 1 n (%)	Grade 2 n (%)	Grade 3 n (%)	Grade 4 n (%)	p-value
Upper abdominal	2 (40.0)	2 (13.3)	0 (0.0)	0 (0.0)	0.26
Pelvic	3 (60.0)	7 (46.7)	2 (28.6)	1 (100.0)	0.49
Midline laparotomy	0 (0.0)	6 (40.0)	3 (42.9)	0 (0.0)	0.30
Laparoscopic	0 (0.0)	1 (6.7)	2 (28.6)	0 (0.0)	0.35

CT patterns and management outcomes

CT findings were also examined in combination with other imaging modalities. The patients were grouped into seven patterns based on the presence (Y) or absence (N) of mesenteric edema, small bowel feces sign, and free intraperitoneal fluid. The most frequent pattern was the absence of all three signs (NNN, 36.6%), followed by the isolated small-bowel feces sign (NYN, 19.5%) and isolated mesenteric edema (YNN, 14.6%) (Table 5). When these CT patterns were

compared across key outcomes—successful conservative management, performance of surgery, overall conservative management, and failure of conservative therapy—no significant associations were found (all $p \geq 0.18$). In practical terms, neither individual CT signs nor their combinations were able to reliably distinguish patients who would respond to conservative treatment from those who would eventually need surgery in this cohort

Table 5. CT finding combinations and their frequencies

CT pattern (mesenteric edema / feces sign / free fluid)	Frequency (n)	Percentage (%)
NNN	15	36.6
NNY	5	12.2
NYN	8	19.5
NYY	2	4.9
YNN	6	14.6
YNY	2	4.9
YYY	3	7.3

DISCUSSION

Adhesive small bowel obstruction (ASBO) remains one of the most troublesome sequelae of abdominal surgery, despite decades of efforts aimed at prevention and better management [1,2]. In this prospective single-center cohort, almost all patients were initially treated according to current recommendations, with a structured trial of conservative management before surgical intervention was considered [3]. Even so, only about one in three improved without an operation, and nearly two-thirds ultimately came to surgery [4].

These figures mirror the failure rates reported in larger series and underline an uncomfortable reality: guideline-concordant conservative care does not, by itself, guarantee avoidance of surgery in a substantial proportion of ASBO patients with ASBO [3,4,9].

The Bologna guidelines emphasize nonoperative treatment for up to 72 hours in the absence of

strangulation, peritonitis, or ischemia [3, 7]. Our practice follows this principle, with routine nasogastric decompression, fluid resuscitation, and close clinical observation. However, the high eventual surgery rate and longer hospital stay in operated patients highlight how narrow the window can be between a safe conservative trial and potentially harmful delay [1, 9].

The crucial challenge for the surgeon in a busy emergency setting is not whether to begin with conservative management but how to decide, early and with confidence, when a patient is unlikely to benefit from it and should be taken to surgery without delay [3, 4]. It is important to remember that this is not a denial that the scores or imaging features that were evaluated were predictive of failure of conservative management or surgery in the past, but rather an acknowledgment of the context in which they were examined: most studies were retrospective and involved larger, more



heterogeneous studies with different imaging thresholds and surgical indications [7, 9, 11, 16].

In the real world, the current literature, combined with our experience, suggests that no single CT characteristic, as typically reported in routine practice, is reliable enough to replace clinical judgment for predicting the course of ASBO [3, 11]. This is important for clinicians at the bedside and should be used to reinforce, rather than supplant, clinical judgment when using imaging as part of the triage process. If there is persistent pain, continued vomiting or distention, systemic disease, or failure to improve early after decompression, then each individual radiologic descriptor is unlikely to be important [3, 4, 16].

Localization in most patients with single-band lesions supports the idea that a multifaceted approach to prevent and reduce adhesions at the time of index laparotomy, including gentle tissue handling and attending to peritoneal surfaces, and thoughtful use of adhesion-reduction strategies, may result in meaningful reduction of downstream obstruction; however, the occurrence of dense or complex adhesions in a subset of patients reinforces that even apparently simple cases can become technically challenging and carry a real risk of enterotomy.

The outcomes of these procedures were consistent with those reported in the literature on ASBO. In terms of the type of surgery, many centers did not differentiate between open and laparoscopic access; rather, they focused on the timing of surgery, noting that they operated too late when patients were deteriorating and too early when they were expected to settle [1, 4, 9].

This study has a number of strengths. However, there are some limitations to be considered: it was a prospective study with predefined variables and systematic description of clinical and CT findings, as well as in the operating room, which helps to minimize the biases often encountered in retrospective designs. The study population was small and was limited to one institution, further reducing the statistical power to detect possible subtle associations with imaging features, and cutoffs for conservative or operative treatment were determined by the individual surgeons' clinical judgment, introducing selection bias into the results.

Considering the strengths and weaknesses of the present work, currently, the most sensible strategy is what is most practical: a combined clinical and CT guided approach, close monitoring and a proactive attitude towards timely surgical correction in patients who do not improve or appear to be getting worse.

CONCLUSION

The majority of patients in this prospective ASBO cohort needed surgery after an initial conservative treatment attempt, and commonly evaluated CT features were not a good predictor of the failure of conservative treatment or surgery. There was significant morbidity associated with operative treatment and a longer hospital stay, and intraoperative findings were more likely to show localized single-band adhesions after midline and pelvic laparotomy. The findings of this study justify CT as the main method to confirm diagnosis and rule out obvious complications, and timing surgery primarily on clinical course and decompression response while awaiting the validation of more powerful predictive models.

Take home points

- Most ASBO patients eventually required surgery despite an initial conservative trial.
- Routine CT signs (mesenteric edema, feces sign, and free fluid) did not predict who would fail conservative management.
- CT can help confirm the diagnosis and rule out complications but cannot alone determine the timing of surgery.
- Localized single-band adhesions after midline/pelvic laparotomy were the most common intraoperative patterns.
- Surgery carried notable morbidity and longer hospital stay, so early recognition of non-responders is crucial

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